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NEW YEAR'S GREETING.

We extend a most hearty New Year's Greeting to our readers and the electrical fraternity at large, trusting that all will find the year as profitable as it is promising, and that still greater truths may be revealed to the patient laborers in scientific research.

FUEL INTO ELECTRICAL ENERGY.

If during the year 1896 progress has not been made in the direct conversion of fuel energy into electrical energy, there has taken place a considerable stimulus in this line, which cannot result otherwise than beneficial. The possibilities which open up to the successful generator of electrical energy direct from the energy of fuel are enormous, if it combines the features of higher efficiency than that attained by existing methods, and at the same time materially decreases the first cost of the plant, depreciation and operating expenses. It is from this view point that Prof. Thomson, in a communication to our columns, looks upon the problem. If only the efficiency of conversion is increased, maintenance expenses remaining the same, Prof. Thomson believes it will pay better to look after the load factor and attempt to smooth off the peaks rather than to adopt such a new form of energy. Great improvements are likely to be effected within the next few years in the operation of central stations, mainly brought about by maintaining on the generator a uniform normal load, by increasing the steam pressure, by super-heating, by a more general use of economizers and by careful attention to the recognized conditions for economical operation. The difficulties to be overcome in attaining these improvements are many, while at the same time an increased first cost and depreciation are to be expected.

The greatest part of the stimulus of the year has been brought about by the announcement of the Jacques carbon battery, and although Dr Jacques has not materially added to existing knowledge concerning this type of cell, a fact easily explained, if we may be permitted to judge from a recent contribution to *Harper's Monthly*, not a little has been gleaned through the careful treatment which it has received by Mr. C. J. Reed. Those who have perused Mr. Reed's articles which have appeared in THE ELECTRICAL WORLD during the past year, will find the one which is published in other columns of this issue equally instructive.

UNIDIRECTIONAL VACUUM TUBE DISCHARGES.

Many will doubtless be interested in the communication by Prof. Trowbridge on a "High Tension Accumulator" which has lately been constructed by him and described in other columns of this issue. Prof. Trowbridge has demonstrated the most interesting and valuable fact that for vacuum tubes such as he employed, a battery discharge of 10,000 volts was not sufficient to produce Röntgen rays. The question arises whether any rays will be found when still higher potentials are employed. The few facts which he points out regarding the nature of argon when subjected to a battery discharge, will apparently open up a most valuable line of research.

It is interesting to note in this connection the experiments which Hertz performed with the cathode discharge, in which a Planté battery of 1000 cells was employed, giving a difference of potential of about 1800 volts. It had been maintained by some of the most prominent investigators that the cathode discharge produced by a large battery was discontinuous, notwithstanding the fact that

Hittorf, as early as 1879, pointed out that such would be the case only under certain conditions. Hertz experimented with low vacuum tubes and found, as had Hittorf previously, that with a sufficiently large resistance inserted in the discharge circuit, the discharge is discontinuous, a fact readily perceived by the note emitted. As the resistance is gradually diminished the note becomes higher until a point is reached when it suddenly stops and the discharge becomes continuous, while the tube is brighter than ever. In this connection Hertz has pointed out that cathode rays themselves are invisible, and that they become visible only when absorbed by the gas contained in the tube. He also showed that in all probability different kinds of cathode rays exist, having properties merging into one another, the difference lying in their properties of phosphorescence, absorption, and deflection by a magnet. These results have a direct bearing upon the line of investigation which Prof. Trowbridge is pursuing, and at the same time are doubtless intimately connected with the production of Röntgen rays.

PARALLEL OPERATION OF ALTERNATORS.

The practicability of operating alternating-current machines in parallel was demonstrated by Dr. John Hopkinson as early as 1886, but owing to the use of comparatively high frequencies, smooth-core armatures and belted machines, the attempts made to operate such commercially proved unsuccessful. As a consequence little has been done in this country in this line until a comparatively recent date, thus imposing upon alternating-current stations an unfavorable condition as compared with direct-current systems. Modern practice has more fully demonstrated that increased economy, convenience and reliability are to be derived by operating units and feeders at their full-load capacity, a result more nearly attained by parallel operation. The machines which but a few years ago were thought to be inadequate for parallel working may now be so operated without serious difficulties, and in fact machines of widely different types, vol tages and outputs may be used on the same circuits.

In an article which appears in other columns of this issue Mr. Steinmetz points out several of the mechanical difficulties which exist in parallel operation. The more pronounced electrical difficulties, such as they were, have been overcome mainly by the use of the modern direct-connected ironclad type of alternator which possesses sufficient armature reaction and self-induction to prevent excessive cross-currents, and therefore severe mechanical strains, and although these factors do not permit of the maximum synchronizing torque available with smooth-core armatures, they are not so large as to prevent a torque sufficient to maintain reliable parallel working. With the ironclad alternator no elaborate synchronizing devices are necessary, care being taken simply to bring the machine which is to be brought in parallel with one already running to a speed slightly above that of the other, when it will fall into step. By the use of wattmeters in the respective machine-circuits each machine may be made to take its share of the load by properly varying its field excitation. If excitation is maintained near the normal, approximation to the minimum synchronizing current will be ensured and the machines will not be unduly loaded, by idle currents. As pointed out by Mr. Steinmetz, rigid mechanical connection between alternators is not to be considered as synchronizing inasmuch as the machines become practically one. At the same time such a method introduces adverse conditions by preventing sufficient flexibility of the system and the proper phase relations between the armature currents, thereby causing excessive cross-currents. Of the three principal factors for successful parallel operation, equality of frequency, equality of phase and equality of voltage, the first is the most important, while the second is important if flickering of lights is to be avoided.

ETHER THEORIES.

An explanation of the ultimate nature of the ether is the goal toward which scientific research of the present day is striving. The question arises whether the goal is to be attained by conjectures and hypotheses, or by carefully studying the facts obtained by experimental investigation. The latter method seems the more plausible and the line along which investigation is to be continued is doubtless that which will most clearly reveal the connecting link in the chain of evidence thus far sufficiently completed to indicate beyond doubt a most intimate relation between light and electromagnetic phenomena. The determination of the mechanism by means of which electromagnetic forces act upon ponderable matter will under the light of existing conditions lead to the desired end. It will be, therefore, most likely by a careful study of magnetic and electric phenomena, especially of electro-chemistry, and their relation to the phenomena of light, that a complete theory of the ether can be formulated. It is quite generally admitted, we believe, that little or nothing at present is known regarding the physical properties of the ether, and further it is much as Prof. Rowland remarked at the last meeting of the Institute, the more facts placed at our disposal the more complicated becomes the situation, until the mind becomes in a whirl and one is forced almost to give up reasoning regarding them.

We are forced to believe that it will not be by any method of mathematical juggling that a satisfactory ether theory will be enunciated, and it is for this reason that Prof. Fessenden's article "On the Prospective Development of Ether Theories" is undoubtedly based on an incorrect assumption. The method of treatment which Prof. Fessenden pursues is most interesting, and it is not impossible that with a more extended development, results of value may be obtained, but the fact should not be lost sight of that by means of a treatment such as he uses little more is to be derived from the mathematics than that which is put in them.

Prof. Fessenden's memory concerning Maxwell's discovery of the electromagnetic nature of light has apparently failed to serve him, for we do not find in Maxwell's scientific papers any statements which substantiate the inference which Prof. Fessenden has drawn, to the effect that it was the theory of dimensions which led Maxwell to make his grand discovery of the electromagnetic theory of light, but on the contrary it seems evident that such was not the case. In his paper, "On the Dynamical Theory of the Electromagnetic Field," Maxwell states that from his general equations of the electromagnetic field, of which there were 20, containing 20 variable quantities, he has shown the possibility of magnetic disturbances, propagated through a non-conducting field, transverse to the direction of propagation, and that the velocity of propagation is the value which expresses the number of electrostatic units in one electromagnetic unit. Furthermore, he distinctly says: "The conception of the propagation of transverse magnetic disturbances to the exclusion of normal ones is distinctly set forth by Prof. Faraday in his 'Thoughts on Ray Vibrations.' The electromagnetic theory of light, as proposed by him, is the same in substance as that which I have begun to develop in this paper, except that in 1846 there were no data to calculate the velocity of propagation." The above statements would indicate that more credit is to be given to Faraday for his magnificent researches than to any theory of dimensions which Maxwell may have employed.

Beneficial Effects of a Shock.

In a statement in the London *Lancet*, in which a victim describes the effects of an accidental shock from a 2500-volt alternating-current circuit, he says that there were no after effects, excepting that he felt himself "decidedly better in general health."

A Review of the Year 1896.

THE year 1896 has brought developments in the field of discovery, in the practical applications of electricity, and as usual, in electrical jurisprudence. Foremost in the domain of scientific discovery are the phenomena connected with the production and utilization of Röntgen rays. Very early in the year the discoveries of Röntgen were made public in this country, and the subject was immediately taken up with an interest which was in its intensity and generality extraordinary, if not unique. It was to be expected that physicists and other scientific men would be deeply interested in the discovery, but the unbounded enthusiasm of the unscientific multitude was unlooked for, and requires a special explanation. This explanation is found in the glamor of mystery surrounding the subject in general, of seeing through substances which are opaque to light, but above all in the visibility of the bones and other internal organs of human beings and animals. The mere fact of radiations passing through bodies which are opaque to light (such for instance as Hertzian waves, which only differ from light waves in length), does not excite the public curiosity greatly, but the ability to convert the Röntgen ray effects into visible results by both photography and fluorescence, so as to virtually see the hidden interior of things, does appeal strongly to the public.

The strange name, "X-rays," probably contributed to the popular sense of mystery, and it is a significant fact that it is always used by charlatans, and usually by writers and speakers who desire to produce a dramatic effect. At the same time, as Röntgen himself was the author of the name, it can be defended even by those who deliberately use it for the purpose of mystification. The general phenomena of the Röntgen rays are so well known that it is not necessary to mention them here. The reliable results so far obtained are chiefly experimental, as most of the theoretical deductions need thorough testing before they can be safely accepted, and many of them have already proved inadequate.

The late experiments seem to indicate that there is genuine reflection of Röntgen rays as well as diffusive reflection. If this reflection be proved some of the tentative theories will have to be discarded. Every number of THE ELECTRICAL WORLD, during the early part of the year, contained one or more references to Röntgen rays.

Among the advances in experimental science, of both theoretical and practical importance, is the experiment of Messrs. Houston and Kennelly (THE ELECTRICAL WORLD, July 4) on the seat of electrodynamic force in iron-clad armatures. The carbon-consuming battery of Dr. Jacques has excited considerable interest from a theoretical point of view, and great things are expected of it commercially. The original theory of the cell, that the carbon performs the same function as the zinc in the usual forms of cells, seems now to be completely overthrown. The experiments of Mr. C. J. Reed (THE ELECTRICAL WORLD, July 25), show that the action is more nearly akin to that of the thermo-couple. The commercial importance of the Jacques cell is still problematical, but even if it be a cheap enough source of current to pay under any reasonable conditions, it certainly is not so efficient a source as the inventor at first thought. The electrolyzed carbon, though apparently proportional to the current output, does not necessarily contribute to the energy output, which comes from the fuel consumed in the furnace.

In practical engineering one of the most important events was the transmission of power from Niagara Falls at Buffalo. At midnight, Sunday, Nov. 15, the transmission became an accomplished fact, and the long period of anxious waiting of the engineering world was at an end. At the starting (THE ELECTRICAL WORLD, Nov. 21) the chief officers of the power company, and representatives of the other companies who took part in the work of construction, were present, some at Buffalo and some at Niagara Falls. The commercial success of the transmission seems to be assured, although the profits are probably not so great as was hoped and expected when the enterprise was first projected. The apparatus at present in use (THE ELECTRICAL WORLD, Nov. 21, *et sec*,) was built for the most part by the Westinghouse and General Electric Companies, and probably enbodies in many instances the results of the best engineering talent of the times. But, on the other hand, there has been no undertaking in electrical engineering which has been more adversely criticised either here or in Europe, and it is not to be supposed that there have been no mistakes made at all. The dreams of the cities of Chicago and New York supplied with Niagara power to the exclusion of steam, and even of Niagara propelled Erie canal boats, it is needless to say are not yet materialized. It is wise to compete with steam power in Buffalo before trying New York.

Among the engineering enterprises which have been watched with interest is the Lenox Avenue conduit trolley road in New York City. The operation of the road through the past Winter (THE ELECTRICAL WORLD, March 21) was successful, and it has got along bravely through the two snow storms of the present Winter, and has had but one mishap of any consequence up to the present time, the cause for which has been effectually overcome.

Another interesting development of the year is the tri-phase railway at Lugano, Switzerland (THE ELECTRICAL WORLD, Feb. 22, March 21, April 18.) This is the first commercial operation of a polyphase railway, but later reports (THE ELECTRICAL WORLD, Oct. 10) mention the operation of the railways of the Boleo Company's copper mines, and the coal mines at the mouth of the Rhone by triphased currents.

Acetylene gas has come into great notoriety during the year. The production of calcium carbide by electrical means being the first step in the manufacture of the gas, the process is considered a branch of electric industry, although the finished product burned like ordinary illuminating gas is trying to be a competitor of the electric light. The first public announcement of the process (THE ELECTRICAL WORLD, Feb. 1) put the cost of calcium carbide low, and later returns gave widely differing figures. Of course, the cost of power is one of the chief items of expense, but the discrepancy in the estimates is too large to be accounted for even by the difference in price between the dearest and the cheapest power.

The use of high-voltage incandescent lamps has increased considerably in the past year, both in England (THE ELECTRICAL WORLD, April 11), and the United States (THE ELECTRICAL WORLD, July 18). The United States Custom House in New York City is a well-known instance of the use of double-voltage lamps, and there seems to be no reason why they should not be more extensively employed in future.

Vacuum tube-lighting has not been backward so far as promises and public exhibitions are concerned (THE ELECTRICAL WORLD, May 30), and the quality and efficiency of the light seems to be greatly improved, but the profound silence of the past few months can scarcely be considered the forerunner of its adoption in commercial use.

One of the important events of the year was the electrical exhibition held in May. This is the first purely electrical exhibition ever held in New York City, and was a great success, both financially and otherwise. The interest of the public was keen, and in consequence the attendance was large. The roar of Niagara over the telephones, the Röntgen ray exhibitions, photographs by the arc light while you wait and such like, were great popular inducements, and perhaps contributed more toward the success of the exhibition than the more solid material which was to be found in other parts of the building.

In the way of legal decisions affecting electrical interests we had early in the year a decision of the United States Circuit Court of Appeals (THE ELECTRICAL WORLD, Jan. 25), reviewing the Rochester decision of Judge Coxe, and later a decision of the Appellate Court, reversing Judge Townsend's New Haven decision (THE ELECTRICAL WORLD, Aug. 8). Both of these cases involved the Van Depoele trolley patents, and in both cases the Appellate Court granted the patentee less than the lower court, which is probably considered just by the electrical profession at large. The last decision exemplifies the common saying that law is the difference between tweedledum and tweedledee, in a striking manner. Under this decision it is necessary that the patent owners should have an accurate record of the history of each individual trolley after it is sold, in order to prove infringement. Judge Coxe's decision of the electrical fixture patent (THE ELECTRICAL WORLD, March 28), sustaining the broad claims, is also of importance to the profession.

Under this decision the insulating joint between the fixture and the rest of the piping system is a high-class invention. However useful such a joint may be, or even allowing that it is indispensable to good engineering in certain cases, the electrical profession at large had not discovered that any high order of cerebration was necessary to its evolution, until this decision enlightened them.

The American Institute of Electrical Engineers has had as usual interesting papers and discussions during the year, but the annual meeting was very tame, not to say flat. The papers were good, but few in number, and the discussions as a whole not up to the usual standard. The explanation is, in the opinions of those most familiar with the Institute, that the electrical exhibition absorbed the greater

part of the enthusiasm and attention of those who would otherwise have taken an active part in the Institute meeting. It certainly is beyond dispute that whatever advantages may accrue to the other bodies by association with the Institute, no meeting of the Institute held in conjunction with or under the auspices of another organization, has ever redounded to the credit of the Institute. The Convention of the American Street Railway Association (The Electrical World, Oct. 31) was the most important in the history of that body so far as exhibits and attendance are concerned ; the papers read were also good. The New York Electrical Society has maintained its usual standard during the year.

Fuel Energy Into Electrical Energy.

BY ELIHU THOMSON.

Notwithstanding the fact that in these days of long-distance transmissions at high voltages the energy of large water powers will become more available, and also in spite of the fact that the fuel cost constitutes, in many cases, not more than 12 to 15 per cent. of the total cost attending electric distribution from stations, the problem of how to obtain an increased efficiency or a greater percentage of the potential work of a fuel as electric energy loses none of its interest. In localities where coal is cheap the actual fuel cost in the working of a plant may be such a small percentage of the total cost in interest, wear and tear, administration, supplies, renewals, etc., as not to be worth considering, since if even 100 per cent. conversion could be attained from fuel to current the saving would be almost negligible.

It is certain also that if in obtaining any increase of yield the outlay for additional plant, or for more costly plant, or for maintenance and attendance, is such as to give rise to an increased charge of but a moderate percentage over the present costs, there would be a neutralization of benefits. Despite then the interest which the working out of any problem naturally has for the scientist and engineer, it remains a fact that any new plan or proposal for increasing the percentage of fuel energy rendered available, must, to be commercial, accomplish its results within such limits of cost and outlay as will depend on the cost of fuel in the particular locality where the plant is to operate.

By the use of triple-compound condensing engines at full load one horse-power-hour may be developed at an expenditure of fuel of less than one and a half pounds of coal, a figure which is so low that in any locality where coal can be had for less than $5 per ton, places the actual coal cost for full load conditions on a favorable basis as compared with other outlays in the working of an electric plant.

Indeed, the question of uneven loads and peaks in the load becomes then one of far greater commercial importance than saving of fuel alone, when the plant is working at its best, for the great waste of fuel comes in putting boilers into and out of service, while a large engine but lightly loaded is itself a wasteful piece of machinery. Any plan of fuel saving which, while providing for a given output is not flexible, or which does not lend itself easily to a system of storage, might have all its value neutralized in consequence.

Much has been said from time to time concerning the advantages of gas or oil engines as prime movers, and it is certain that their efficiency of conversion may easily rise to 20 per cent. of the energy value of the gas or oil supplied.

Even in quite moderate sized engines, such as those of 30 horse-power and under, one brake horse-power-hour has been produced for less than three quarters of a pound of anthracite coal made into gas by one or other of the producer methods, while in oil engines of the gas engine type the oil consumption is, even for quite small engines, about one pound per brake horse-power-hour.

There is reason to believe that with the work which is being done in improving the engines and producing gas under most economical conditions, with fair sized engines, power may be generated on the basis of about one half pound of coal or oil per brake horse-power, or possibly somewhat better in the case of the oil owing to its relatively high calorific value.

There can be no question about the advantages which such fuel engines have in not requiring any consumption of fuel until they are started. Similarly, when stopped, fuel consumption stops. For a given horse-power output, however, the gas engines are probably more expensive as to first cost, while they require attention from time to time, as in cleaning, etc., which is not the case ordinarily with steam engines. The attention to boilers required in a steam plant might be offset in part at least by the care of a gas-producing and storing plant. Strong objections, both to gas and steam-engine plants of large size in cities, arise from the almost unavoidable tremor or vibration communicated to surrounding buildings. This fact has of itself led to the adoption of the Parsons steam turbine in a station in London, and may have a like effect in other places.

Whether a gas or steam engine be employed as a source of mechanical power, the conversion of the potential energy of the combustible into electric energy is not direct, but is made through the heat of combustion conferring kinetic energy on a mass of gas, which energy is partly connected into mass movement or mechanical energy, the piston being driven thereby.

Similarly the many attempts to employ the thermo-electric principle rely upon an indirect conversion, but in this case there are no moving parts and the mechanical energy stage is missing. The heating of junctions of dissimilar metals in a thermo-electric series and the production of currents of electricity thereby, seems at first the ideal of simplicity and practicability, but, unfortunately, despite many most noteworthy efforts to improve the thermo-electric pile, its efficiency remains very low.

It is doubtful whether a better economy than 1 per cent. of the energy of the fuel, delivered to the outside circuit of the pile, can be attained even with the latest and best constructions. The actual construction and working of the piles themselves as well as their permanency have undergone great improvement in recent years, but there remains the fact that of the total heat conducted from the hot to the cold junctions, but a very small percentage is converted, or convertible perhaps, into electric energy. The pyro-electric generator of Edison would naturally be open to the same serious objection of insignificant yield.

The remaining type of apparatus for effecting the conversion in question is that in which the fuel or carbon is dissolved as is the zinc in a battery cell, while air or some other oxidizing agent acts as a depolarizer.

Many years ago Jablochkoff devised a hot battery in which nitrate of potassium or nitre was fused in an iron pot which was made one pole or terminal, and a carbon stick dipped into the fused nitre was the other pole. Violent reaction occurred due to the oxygen of the nitre attacking in its hot state the carbon piece, while a fitful current of small energy value relatively to the activity of chemical reaction going on was noticed to flow in a circuit from the pot to the carbon.

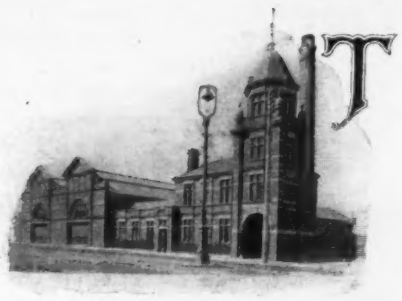
Recently the battery of Dr. Jacques has commanded considerable attention. It would seem that in this battery there is in fact an actual quiet consumption of carbon without real combustion. The bath of melted sodium hydrate contained in an iron cylinder has bubbles of air passed up through it from which oxygen is taken up. The carbon rod immersed in the soda bath is gradually oxidized and a current obtained which leaves the carbon in the bath to go to the iron containing vessel and through an outside circuit from the iron to the carbon. It is claimed that as high as 85 per cent. of the energy represented by the solid carbon is thus converted into electrical energy available for use. There are of course difficulties, and perhaps the chief one is the carbonating of the sodium hydrate. Unless a bath can be found which does not form carbonate, and which therefore permits the free escape of carbonic acid gas, this difficulty might indeed be fatal. The handling of fused alkalies is not as easy as might be desired and the renewal of carbons in battery cells is of course an objection, while the contacts to be provided for large currents passing from cell to cell through hundreds of cells appear indeed formidable The Jacques battery also will require specially pure fuel molded carbons so as to be of proper form and a good conductor of electricity.

In view of all this the central station manager need not, for the present at least, fear having to throw aside his boilers and engines. There does not at present loom upon the electrical horizon any such formidable competitor of the ordinary modes of generating electricity from fuel as need give him uneasiness about the value of his present plant, or give rise to any roseate visions of increased earnings due to the substitution of some new mode of generation.

The smoothing out of the hills and hollows in the load diagram is apparently of more real importance in his case than systems which would double or treble the present coal efficiency, by which is meant the percentage of energy value of the fuel converted into electric current energy.

The City Council Electric Light Plant in Melbourne, Australia.

BY FRANK W. N. KING.



THERE are three private working electric light companies in Melbourne, Victoria, but the one upon which these remarks are based is that of the Melbourne City Council, which is by far the most complete and extensive of any station perhaps in the Southern hemisphere.

The cost of lighting the public places in the City of Melbourne last year was as follows :

For lighting the streets,	$91,500
Private electric light company for the markets,	5,500
For lighting other markets,	2,990
Or a total of	$99,990

The cost for lighting the streets and markets with electricity by the Melbourne City Council for the past fiscal year was $95,275. which includes 4 per cent. interest on $405,000, and 7½ per cent. depreciation on the same amount. Thus it is seen that a saving of $4715 per annum with over 300,000 candle power is effected as against 48,000 with gas.

The Melbourne electric light station has been erected upon corporation property covering an area of two acres, the buildings alone covering about one third of an acre. The boilers were supplied and erected by the Babcock & Wilcox Company; the engines, steam piping and pumps by a native firm of Melbourne, the Australia Otis Engineering Company; the shafting by the Longlands Foundry Company, the dynamos and lamps are all of the Thomson-Houston type and the vulcanized india rubber was supplied by the Okonite Company, of Manchester, England.

The buildings consist of a engine and dynamo room 138 x 78 feet, a boiler-house stoke hole 84 x 37 feet, coal bunkers, testing room, stores, fitters' shop, offices and apartment for resident engineer.

The total area of lighting is 4700 acres under the continuous-current series arc and incandescent systems. Arc lamps of 1200 nominal candle-power are used in the main thoroughfares and squares, while incandescent lamps of from 20 to 30 candle-power are placed in the byways and passages. The generating station is located at a point about midway between the extreme ends of the city, and is convenient to the wharf and railway for the delivery of coal. There is a total of 686 arc and 1600 twenty-cp incandescent lamps for the city and suburbs.

The plant is laid out in four sections, each complete in itself. Three of these are sufficient to light the whole of Melbourne, the fourth being at all times a standby in the event of any part of the main section failing. A section consists of one 250-hp boiler, one 300-hp engine, one 30-foot length of shafting, five 50-light arc dynamos and one alternator for supplying 2000 eight-cp incandescent lamps. These alternators, it is said, are sufficient for the present demand for light, and it is proposed, with an increase in demand, to extend the building for the alternating plant and then erect engines and alternators coupled direct for incandescent lighting, so that the spare 400 horse-power on the arc light plant could be used for further extension or increased lighting in the streets when the cost of maintenance will allow of it.

The heating surface of each boiler is 2823 square feet, and the grate surface 51 square feet. The four water-tube boilers are fed by steam pumps of the direct-connecting duplex type, three in all, each having a capacity of 3000 gallons per hour, so that one pump is sufficient to feed three boilers. There are two independent delivery pipes, each boiler being connected to two of them, and the connections to the pumps are so arranged that by manipulation of valves either pump may be connected to either pipe. The suction pipe may be fed from three distinct sources. First, a hot well. Second, a storage tank of 48,000 gallons capacity, supplied from the Yan Yean reservoir and situated under the coal bunkers. Third, from the Yan Yean direct.

The feed-water is forced through an economizer situated in the flue and having a total heating surface of 3750 square feet. It may, if necessary, be forced direct to the boilers. The economizer is divided into two parts so that either half or whole may be used. Before the flue gases enter the economizer and after they leave the same, the temperature is indicated by pyrometers. A draught gauge

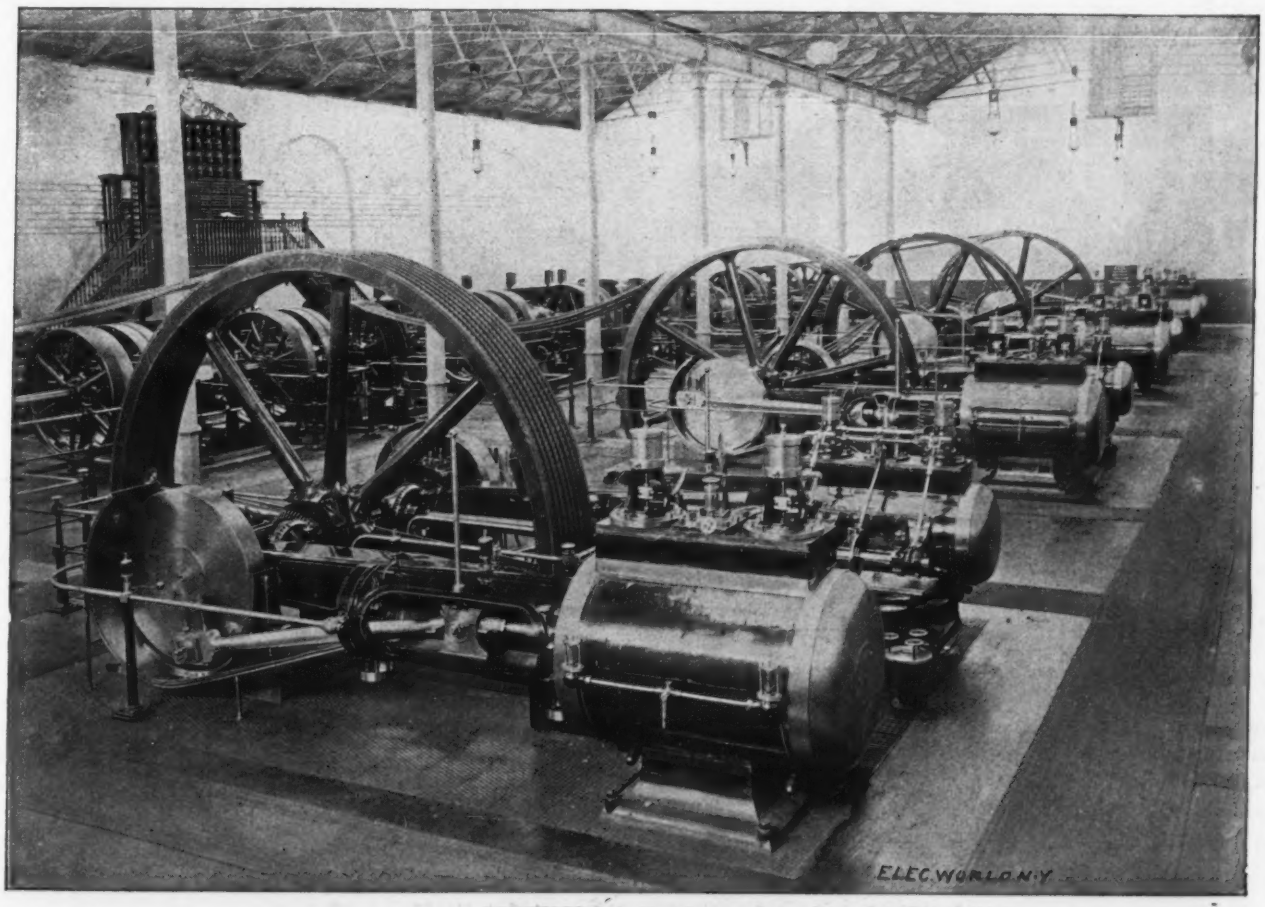


FIG. 1.—ENGINE ROOM, MELBOURNE CITY LIGHTING STATION.

is fixed in the flue as is also a test tube connection for sampling the gases. On the feed water pipes on either side of the economizer, thermometers are attached. The main steam pipe is of steel 10 inches in diameter, has cast-iron flanges, copper bends and expansion pieces. Branching from the main pipe on the boiler side are four supply pipes and on the engine side four connections to high pressure cylinders, each branch having its own valve. There are two valves between the supply steam and delivery steam connections for use in the event of a part of the steam pipe service becoming inoperative. The exhaust main which consists of a 12-inch cast iron pipe, runs the whole length of the building under the floor and branching out to it are the exhaust pipes from the four engines. This exhaust main is connected by valves to two surface condensers each capable of condensing the steam of three engines. The main exhaust is also led into the smokestack, and by the opening of a valve, should necessity arise, the steam may exhaust into the atmosphere. The condensers are located below the engine-room floor. Alongside of each is a separate circulating and air pump. The circulating pumps take their supply from the large tanks underneath the dynamo room, each tank being capable of holding 125,000 gallons of water. This water is pumped up from the River Yarra by compound duplex direct-acting pumps having a capacity of 50,000 gallons per hour. The depth of water in the storage tanks is indicated by floats connected to electric alarms, which ring when the tank is full or contains only two feet of water. The storage tanks are ventilated by pipes in the outer wall of the building. The air pumps deliver into a hot well situated over the flues. The engines, four in number, are of the horizontal compound-condensing type, fitted with the Rowland & Richardson patent trip valve gear. The high-pressure cylinder is 15 inches and the low pressure 26½ inches in diameter. The stroke is three feet, and the engines run at 82 revolutions per minute.

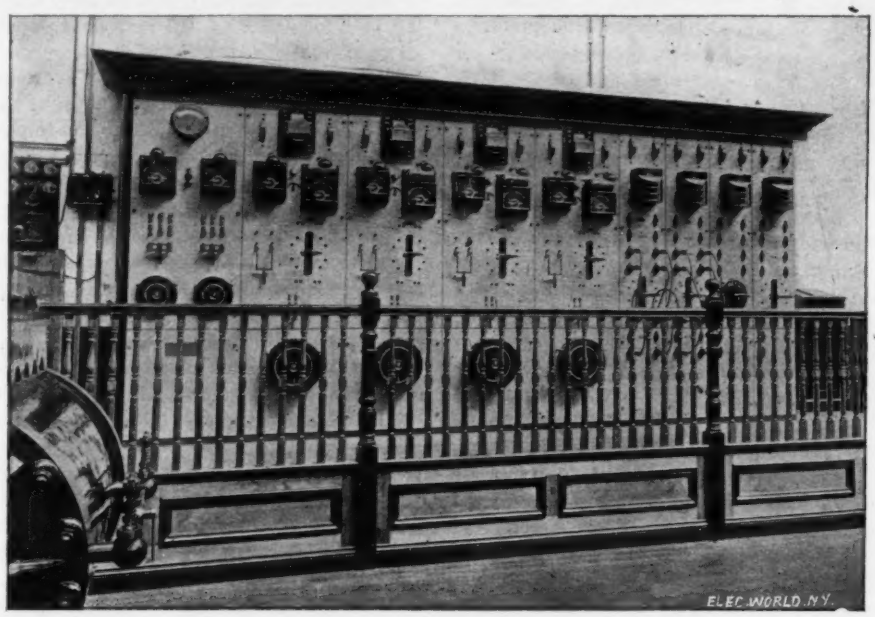


Fig. 2.—Switchboard for Private Lighting.

The fly-wheel is 14 feet in diameter and weighs 10 tons. Each engine drives its own section of 6-inch shafting by seven 6¼ inch ropes. The shaft pulley is 5 feet 7 inches in diameter and has an 8-inch face. Between each section of shafting is a patent friction and claw clutch combined, so that should occasion arise any engine may drive any section of shafting. There are at present 10 dynamo pulleys on each side of the shafting, five being fast and five loose. Double leather belts, 7 inches wide, are used for driving the arc machines. These are of the T-H type of 50 arcs capacity each. The armature is of the new type, a great improvement on the old style of spherical armature. The dynamos, 25 in all, are located above the storage tanks used for condensing purposes. The roof of these tanks consists of 4½ inches of brick arches with a layer of concrete varying in thickness from 4 to 18 inches. It was found necessary, in drilling 80 holes through this roof for the purpose of holding down the machines, to use a vertical electric drill invented by Mr. A. J. Arnot, electrical engineer to the Melbourne City Council. This drill worked most expeditiously and prevented any dis-

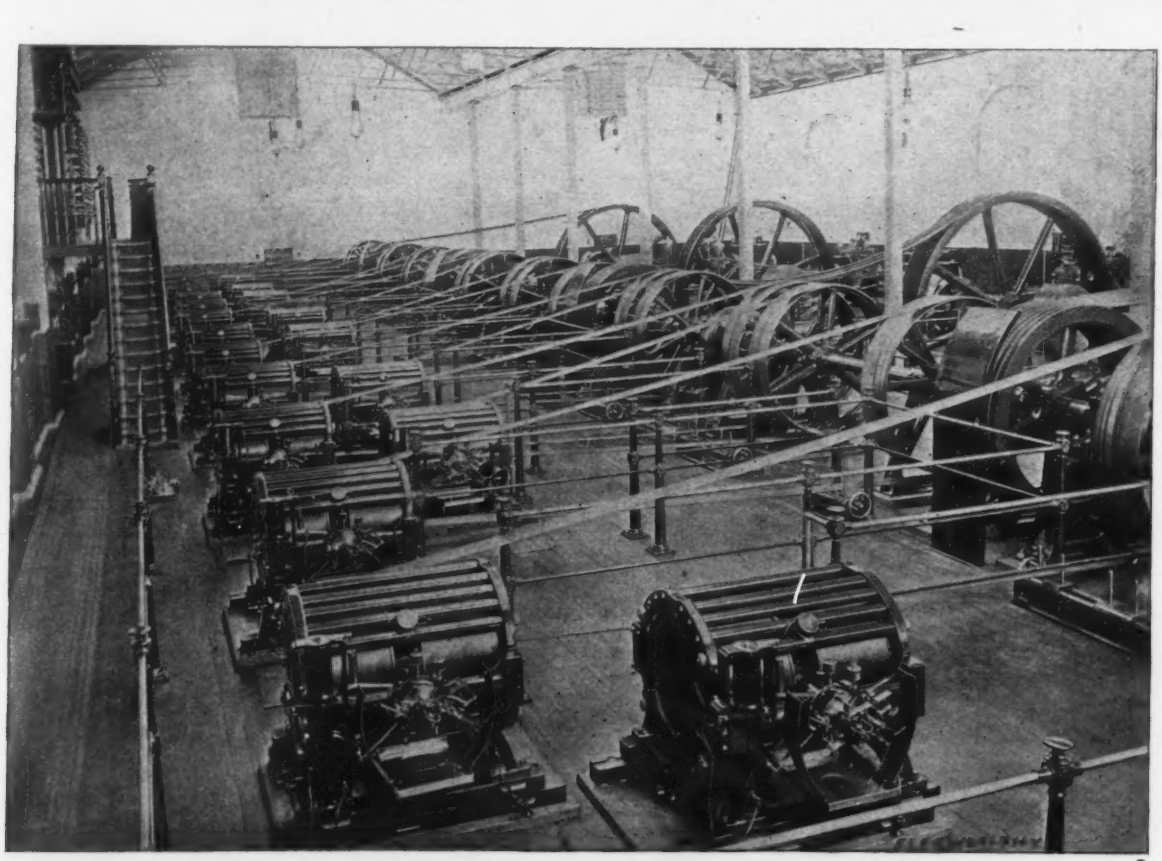


Fig. 3.—Arc-Light Machines in Melbourne City Lighting Station.

turbance of the brick work. The cables from the dynamos are led to the controllers opposite each dynamo, and from these along the wall to the switchboard, which is at an elevation of eight feet from the floor. They are led through composition pipes filled with a bituminous compound. The cables to the street lamps are led out from the back of the board, through the wall, in porcelain tubes to the carrying poles. The system of arc switching is of the latest design. Two shifts of men, seven in each shift, are engaged in the lighting station.

The overhead system of cables has been adopted throughout, but it is hoped in the near future to put electric light leads and telephone wires underground in the leading thoroughfares. The poles used for carrying the cables in Melbourne are of red iron bark of two sizes, 30 and 35 feet long. The thirty-foot poles are fixed with five arms in some cases and two in others; the 35-foot poles generally have seven arms with the exception of a few close to the lighting station which have nine and ten. The arms are mortised into the pole and each pole is machine dressed. The maximum distance between the poles is 53 yards. At any point in the Melbourne streets where arc lamps are used, an individual can comfortably see his way and be able if necessary to read fine print at any time.

Most of the arc lamps are placed on lighting pillars located on alternate sides of the street and the height of the lamp globe is 25 feet from the ground. The pillars used in Melbourne are a combination of iron and wood. The base extending nine feet above the ground, is of cast iron, and the extension piece, to which the cast steel steps are attached, are of gray boxwood. The wood extension passes down the centre of the casting to the ground level where it enters a conical shaped seat. A hole 1¼ inches runs up the centre of the pole to permit of the carrying of the leads to feed the lamps when the cables are placed underground.

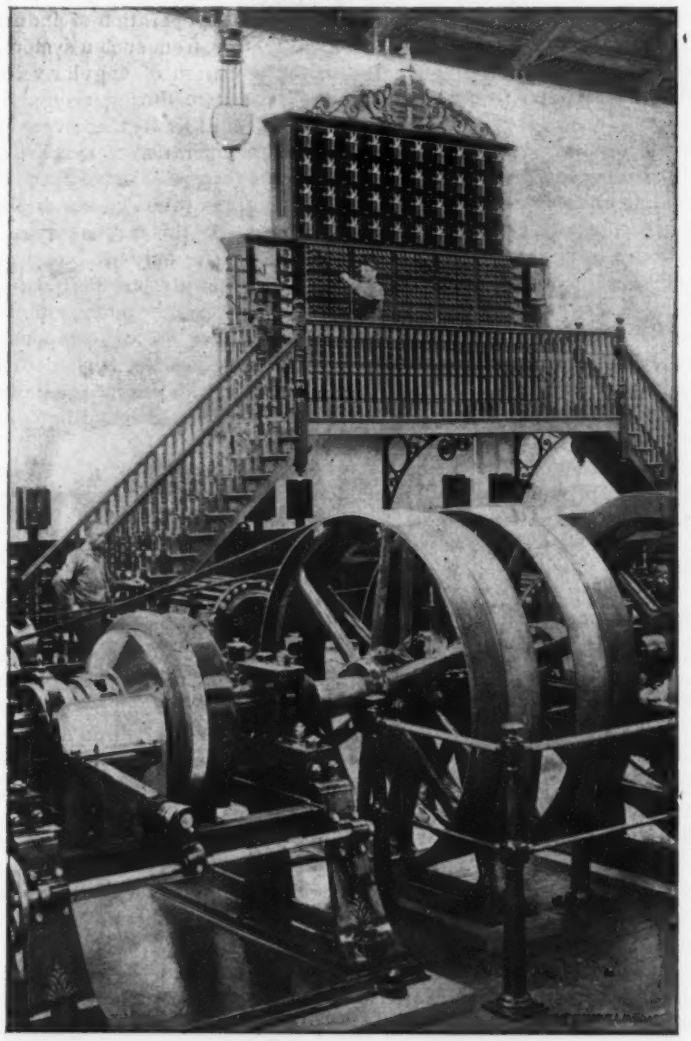


FIG. 4.—ARC SWITCHBOARD.

The incandescent lamps which are placed in the smaller streets, passages, etc., are of the Sawyer-Man type, taking in all cases an arc light current of 6.8 amperes. They are so constructed that should the filament break, the current may pass on by either the fusing together of the platinum wire of the lamp or by the burning through of a thin piece of paper inserted between the two terminals of the lamp within the socket. These lamps are fixed at 14 feet from the ground.

Some circuits of Melbourne have as many as 120 30-cp incandescent lamps and 10 arc lamps in series.

FIG. 5.—FOUR 250-HP BOILERS.

A pound of coal gives 129 watt hours, which is 37 above the average return of 800 electric light companies in the United States, according to published electric light statistics of recent date.

The copper-coated carbons in the arc lamps were found unsatisfactory, and have all been replaced by a better and more suitable type. Vulcanized india rubber cable, of which there is over 215 miles erected, has given much satisfaction.

The insulation resistance, which is tested every day by a dial pattern of Wheatstone's bridge, Thomson reflecting galvanometer of 7000 ohms resistance and 100 Leclanché cells, gives in dry weather about 8 megohms per mile, and in wet weather about 3 megohms.

Some incandescent lamps are remarkable for their life. Three hundred and twenty ran for five months every night and all night, making a total of 1600 hours. The number which burned out in that time was only 28. They were guaranteed for 600 hours.

The writer is indebted to Mr. Arnot, the chief engineer, for information on certain points herein contained.

Electro-Capillary Light.

In a contribution to *Wiedemann's Annalen*, No. 12, abstracted in the London *Electrician*, Herr O. Schutt, of Jena, describes a new electric discharge phenomenon, which he terms electro-capillary light. When the discharge of an induction coil is sent through a narrow capillary tube of about 0.05 m.m in diameter, provided with aluminum or copper electrodes and filled with air under ordinary pressures, an intense luminosity of the tread of air is obtained—a luminosity which is intrinsically far superior to that of the arc, and would form an exceedingly powerful source of light if it could be made continuous. The narrow capillaries deteriorated rapidly, roughening inside and were blown into a series of spherical enlargements. Wider tubes gave less light, but were much more permanent. At the same time the bright lines in the continuous spectrum in the original light became more prominent. At pressures above one atmosphere the phenomena were nearly the same, but the sparks passed with greater difficulty. At low pressures the light became less intense, the continuous spectrum faded, and the bright lines shown out more distinctly. The kind of glass is immaterial. It is stated that the tubes may be made 20 centimetres long and make splendid line sources.

Death of Prof. Du Bois-Reymond.

A dispatch from Berlin, Germany, announces the death in that city on Dec. 28, 1896, of Prof. Emil Du Bois-Reymond, the distinguished physiologist. Prof. Du Bois-Reymond was born in Berlin in 1818. He studied theology, which, however, was abandoned later for natural science. He afterward undertook his researches in animal electricity, on which subject he has published several works. In 1867 he was named perpetual secretary of the Berlin Academy of Sciences, and in 1868 he was made Professor of Physiology at the University of Berlin.

Parallel Operation of Alternators.

BY CHAS. PROTEUS STEINMETZ.

WHEREVER feasible alternators should be operated in parallel, since thereby the whole system can be run from a common set of bus-bars, and the necessity of switching feeders over from one generator to another with the variation of load in the system is avoided. At the same time parallel operation makes all generators of the station act electrically as one large unit, and so greatly improves the regulation, inasmuch as the system is very much less affected by a sudden change of load than a single generator.

Alternators when running in parallel tend to retain their parallelism, and thus exert upon each other a powerful synchronizing force, if some extraneous cause tends to throw them out of step, as for instance the slippage of a belt, etc. In such a case a current passes between the machines accelerating the lagging and retarding the leading machine. The maximum synchronizing power which two alternators can exert upon each other, when in parallel operation, depends upon their armature reaction in the same way as the maximum mechanical output which can be given by these machines as synchronous motors, and is proportional thereto. In machines of very low armature reaction the synchronizing power may be so large as to require careful adjustment to equality of phase when throwing the machines in parallel, to avoid the passage of excessive cross currents at this moment, while in machines of very high armature reaction the synchronizing power may be insufficient to keep them in step in extreme cases, as heavy over-loads, etc. The range of armature reactions used in all modern alternators is, however, such as to offer no difficulty in parallel operation.

Thus the problem of synchronizing alternators is not an electrical but exclusively a mechanical problem. That is, to run satisfactory in parallel, the driving power of the alternators must be such as to allow their keeping in step without undue strains, or in other words the *frequency* of the alternators given by the driving power must be *equal* and *uniform*.

The following are the two main conditions of parallel operation. If they cannot be fulfilled parallel operation is impracticable:

1. *Equality of Frequency.*—Obviously it is not sufficient that the speed of alternators intended for parallel operation is the same (or inversely proportional to their respective number of poles) when running without load, since with load the speed of the one may drop more than that of the other, and thus when running in parallel the latter takes more than its share of the load. Hence, when investigating the feasibility of parallel operation of two alternators, it is to be recommended to connect one pair of terminals of the two machines directly with each other, and the other pair of terminals through the primary of a transformer, whose secondary is closed through an incandescent lamp. Darkness of the lamp then shows equality of phase and brilliancy opposition of phase, and the number of beats made by this phase lamp indicates the slippage of one machine behind the other. If with both machines at no load as well as when loaded independently, the beats of the lamp take place very slowly, the synchronizing switch can be closed and the machines operated in parallel. If the drop of speed from no load to full load of the two machines is not the same the machines will either not share the load equally when loaded, or cross currents will flow at light load, the faster machine driving the slower as synchronous motor.

With composite-wound machines in parallel operation, synchronizers should always be used between the series-fields to ensure proper division of the load.

The parallel operation of alternators when driven from independent engines or water-wheels, with their governors adjusted for equal speed, is most satisfactory. In this case the alternators divide the load in proportion to their driving power quite independent of their field excitation, and very different types of machines can be operated together in parallel in this manner.

Parallel operation by belting from the same shaft is more difficult and great care should be taken to have the pulley diameters and the tension of the belts exactly alike, so as to get identically the same alternator frequency. The most difficulty is experienced in practice by inaccuracy of the pulley diameters giving slightly different frequencies. By such parallel operation from the same shaft all the belts have to be kept at their proper tension, since if one of the belts slackens the corresponding alternator will take less than its share of the load.

By direct coupling from the same shaft, alternators can be operated in parallel only when rigidly connected to the shaft with their armatures set in exact coincidence, and very different types of alternators cannot as satisfactorily be operated together. In the case of rigid connection to the same shaft synchronizing devices are unnecessary, since by necessity the alternators must always be in phase with each other. The field excitation of the machines, however, must be adjusted for equality of voltage, or the machines will not share the load properly.

Coupling of alternators to the same shaft by clutches is feasible only if the clutches are perfectly positive and can catch only in one definite position, that of phase coincidence. Thus ordinary clutches are unsuitable.

2. *Constancy of Frequency.*—The ideal driving-power for alternators is furnished by either water-wheels or rotary engines, since they give a practically uniform torque, and thus uniform angular velocity.

In the reciprocating steam engine, however, during each revolution the impulses and times of zero or low torque alternate, and thus the angular velocity can be kept fairly uniform only by a fly-wheel. Hence heavy fly-wheels are necessary for steam engines driving alternators. With belted alternators having a comparatively small number of poles, this difficulty is not so serious as with slow-speed alternators of a large number of poles direct-connected to independent engines. In the latter case a small variation of angular velocity of the engine, if not exactly coincident with that of the second engine, causes alternately the frequency of the one and then that of the other alternator to run ahead, and thus tends to forcibly throw the alternators out of step, or at least causes large cross-currents to flow between the machines and produces a pulsation of the lights with the period of the engine speed.

If the alternators and engines are identical, this difficulty can, as far as the alternators are concerned, be remedied by synchronizing the engines; that is connecting the alternators in synchronism when the cranks of the engines are in exactly the same position. The same difficulty, however, reappears then in the operation of induction motors, and especially synchronous motors, from such a system, since the pulsating frequency due to the pulsation of angular velocity of the engine forces the motors to accelerate during rising, to retard during decreasing frequency, and thus limits the output of the motors, and in extreme cases makes the operation of synchronous motors or rotary transformers altogether impossible.

Thus uniform angular velocity of the engines intended for direct connection with alternators must be secured. In this respect single-cylinder or tandem-compound engines which give only two impulses per revolution operate badly, and are generally unsuitable for parallel operation of alternators, or for driving alternators supplying synchronous motors or rotary transformers. Cross-compound condensing or triple-expansion condensing engines are best in this respect, providing they are designed so that the engine cylinder divide the load equally at all loads, or two single-cylinder or tandem engines set with their cranks in quadrature.

Non-condensing cross-compound engines frequently give poor service, since at light load in such engines the low-pressure cylinder may give a negative torque.

Equality of frequency and constancy of frequency being provided, practically all alternators will run very satisfactorily in parallel.

If the fields of two parallel-connected alternators are excited for different voltages cross currents will flow also between the machines. These currents however, are different from the synchronizing current and are wattless currents magnetizing the field of the machine of lower and demagnetizing the field of the machine of higher excitation by their armature reaction.

When synchronizing machines with more than two terminals, as monocyclic or polyphase alternators, care has to be taken to have all the different phases simultaneously in coincidence when starting the machines for the first time; otherwise when synchronizing one pair of phases the other phases may be in opposition and an internal short circuit the result. This is found out best by connecting one pair of corresponding terminals directly together and the other pairs of corresponding terminals through the primaries of small transformers with lamps in their secondaries. If all lamps become dark simultaneously, the connections are right and the machines can afterward be synchronized by a phase lamp or synchronizing device in one phase only, but this test should be repeated whenever changes have been made on the switchboard, etc., which may cause a reversal by a wrong connection.

Obviously all considerations regarding parallel operation of alternators can be of a general nature only and may be considerably modified by individual conditions.

On the Prospective Development of Ether Theories.

BY REGINALD A. FESSENDEN.

IN view of the great amount of work which is now being put upon the mathematical theory of electricity, it will be of interest to us to examine what may be our prospects for obtaining a completely satisfactory theory of the ether.

The more usual mathematical methods are of but little use to us in this connection, for here their greatest strength becomes their greatest weakness. The fact that, as Prof. Perry puts it in one of his admirable articles, "If Lord Rayleigh calculates for us the resistance of the mouth of an organ pipe he has determined the end effect of a bar of iron which is magnetized," becomes now a positive danger instead of a convenience, since it tends to obscure essential differences. To pass over many striking instances I would point out that the fact that many magnetic problems can be satisfactorily treated through the concept of magnetic poles has, taken in connection with our very reprehensible definition of unit current, led many electricians to form the erroneous idea that if we represent current by flow of ether and magnetic lines by vortex rings around the wire, the rings must have a rotation about the axis of the wire. In fact all mathematical theories by themselves are merely tentative—are merely attempts at drawing a line parallel to another line of which we only see a small portion, and of which every more extended view necessitates a fresh rubbing out and starting again. The history of the development of the theory of any physical phenomenon, such for instance as that of light, amply illustrates this.

There is another method, however, which is in some ways much more powerful. It might be called "Qualitative Mathematics," and is simply an extension of Fourier's theory of dimensions. Maxwell, Lodge, Rücker, Williams,[1] Heaviside and others have used dimensions in electrical work, and, if my memory serves me, it would appear from Maxwell's letters that he was led to make his grand discovery of the electromagnetic nature of light in this way.

In what follows the writer has developed the method somewhat further. It will be seen that there are two great groups of ether theories, one intelligible dynamically, the other not. This first group may again be subdivided into two divisions, one division implying an ether whose frictional resistance is proportional to the velocity, there being three such pairs of theories; and the other division consisting of a single theory, implying an ether whose resistance to frictional resistance is proportional to the square of the velocity.

The first division of three pairs of theories has received exhaustive mathematical treatment; the second division is, I believe, here published for the first time:

Using the following notation for the three fundamental and eight quasi-fundamental quantities,

q = dimensions of quantity of electricity.
b = " " magnetism.
M = " " inertia.
G = " " gravitational attraction.
k = " specific inductive capacity.
μ = " permeability.
m = " coefficient of medium relating to inertia.
g = " coefficient of medium relating to gravitational attraction.
L = " length.
T = " time.
W = " work.

We may write, since the force between two quantities of electricity is equal to the product of the quantities divided by the square of the distance between them into the specific inductive capacity of the medium:

$$q^2 / L^2 k = \text{force}.$$

By the similar magnetic law,

$$b^2 / L^2 \mu = \text{force}.$$

Hence we get,

$$q/b = k^{1/2}/\mu^{1/2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (A)$$

Since the potential of a circuit is equal to the strength of the current in the circuit multiplied by the quantity of induction passing through the circuit we have,

$$qb = ML^2/T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (B)$$

From Weber's law for the relation between a magnetic circuit and a shell carrying a current we have,

$$q/T \times L^2 \times \mu = bL.$$

Substituting in this the value of q/b from equation (A) we get,

$$k^{1/2}\mu^{1/2} = T/L, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (A)$$

an equation connected with one of Maxwell's most brilliant achievements.

So far, however, we have but three equations, while we have four unknown quantities. Could we but secure another equation from some other phenomenon, we could at once find out the true nature of electricity by simply solving these equations. Unfortunately, however, these three equations embrace the whole domain of magnetism and electricity which has been exactly explored. They also indicate to us certain phenomena not hitherto published.

It might be thought that some of the outlying phenomena might give us what we wish. To consider these in turn:

1. *Hall's Effect.*—The fact that this is only strongly marked in crystalline conductors and is almost absent in perfectly annealed and isotropic materials seems to point to the conclusion that this effect is simply due to ælotropic conductivity produced by the electric and magnetic stresses.

2. *Kerr's Electro-Static Effects.*—Here again we see that all the substances examined fall into two classes; those pure and those containing water and conducting impurities. The former act as positive uniaxial crystals, the latter as negative. Hence we see that in all pure substances the effect can be simply explained by the electric strain, and it may be shown that pure liquids containing conducting particles should, when electrically stressed, behave as negative crystals.

3. *Fizeau's Experiment.*—Here, unfortunately, we do not know whether μ is concerned or not. If the effect were not so small, this would be the most promising line of attack.

4. *Light Rotation Phenomena.*—The phenomena discovered by Faraday, Kerr and others unfortunately seem to bear some relationship to the refracting powers of the substances. Therefore, from Fizeau's experiment, they concern, not the free ether, but the "bound" ether, and do not seem to be available. That any conducting liquid must give optical rotation of plane polarized light when placed in a magnetic field is due to entirely different causes, but unfortunately comes under known laws, embraced in the above three equations.

Abandoning this attempt, let us write, where Z is of unknown dimensions:

$$q/b = Z = k^{1/2}/\mu^{1/2} \quad \ldots\ldots\ldots\ldots\ldots\ldots (A\ D)$$

$$k^{1/2}\mu^{1/2} = T/L \quad \ldots\ldots\ldots\ldots\ldots\ldots (B)$$

$$qb = ML^2/T \quad \ldots\ldots\ldots\ldots\ldots\ldots (C)$$

Solving we get

$$q = M^{1/2} L/T^{1/2} Z^{1/2}$$

$$b = M^{1/2} L T^{-1/2} Z^{1/2}$$

$$k = TZ/L$$

$$\mu = T/ZL$$

It may be seen that all the different theories of electricity can be derived by giving different values to Z in these last equations. But these theories divide into two groups, those dynamically intelligible and those not dynamically intelligible.

Let Z equal $M^p L^r T^s$. Then by inspection we see that for the first group the value of p must lie between $+1$ and -1, that of r between $+2$ and -2, while s may have any value, for when all terms are concerned with a common factor, we can never know whether the absolute nature of a quantity is a velocity, or an acceleration or any higher differential of T, just as we can never know the absolute position of a point in space. We are here at liberty to take that power of T which will give the lowest exponent, in this case $+1$ or -1.

This group may be subdivided. The first division contains three pairs of theories, as follows:

1. $Z = M^{-1} L^2 T$.

Here quantity of electricity $= L^2$,
" " " magnetism $= M/T$,
" specific inductive capacity $= LT^2/M$,
" permeability $= M/L^2$.

If Z has the reciprocal value, then k becomes the density and μ the elasticity.

These are the theories with which the name of Prof. Lodge has become identified through his admirable work on the subject.

2. $Z = ML^2 T^{-1}$

[1] In an extremely interesting paper, *Proceedings Physical Soc.*, XI., 357.

Here quantity of electricity = moment of inertia,
" quantity of magnetism = angular velocity,
" specific inductive capacity = $ML^3 T^{-1}$,
permeability = $1/ML$.

Also the theory derived by giving the reciprocal value to Z.

These theories have been worked upon by Kelvin and Heaviside.

3. $Z = T/M$.

Here current is velocity, voltage is force, and magnetic induction is momentum.

Also the reciprocal theory.

The mathematical structure for these three pairs of theories is the same for all. It is true that one may deal with flow and one with rotation, but by simply endowing the thing flowing with the properties which the rotating thing has, we arrive at the same results by the use of the same formulæ. Instead of dealing, for instance, with the flux of a substance, we deal with the flux of a rotation.

Consequently, if one of these theories has a defect all have it in common, or, if any one does not have the defect, then by a change in the properties of the medium all can be freed from it. Now all these theories have one defect in common. This is that they do not allow for the loss through resistance to both electric and magnetic currents, and that if we suppose there to be no magnetic current and fix the medium so as to allow for the ohmic loss, then we have trouble when the electric force passes from one medium into another. So far no success has attended efforts to overcome this difficulty, and I do not see how the defect can ever be removed, for it will be noted that, in all these theories, either quantity of magnetism or quantity of electricity is something which has no dimensions in M.

Now, since we never have these quantities except at the interface of two media, it seems to me inconceivable that either one should be devoid of a term containing M in its dimensions. If we accept therefore as impossible of conception the existence of a magnetic pole or of an electric charge, in free ether, we are driven to abandon all these theories.

The second division of the first set of theories is alone free from this fault. There is only one theory in this division, and this is got by making the dimensions of Z equal to zero. This gives us,

$$\text{quantity of electricity} = M^{\frac{1}{2}} L / T^{\frac{1}{2}}$$
$$\text{quantity of magnetism} = M^{\frac{1}{2}} L / T^{\frac{1}{2}}$$
$$\text{specific inductive capacity} = T / L$$
$$\text{permeability} = T / L$$

The ether got from this theory differs from the ethers of Lodge, Heaviside and Kelvin and Larmor in that frictional resistance to rotation varies as the *square* of the velocity, and the pressure varies as the velocity, In the other ethers the frictional resistance varies directly as the velocity.

So far as the writer has gone, this ether seems to be remarkably free from defects, and a fuller treatment will be published later.

We might have been prepared to accept this result by symmetry, for, from equations (A,) (B) and (C) we might have considered it probable that

$$\begin{vmatrix} (q + k^{\frac{1}{2}}) & (M^{\frac{1}{2}} L / T^{\frac{1}{2}} - T^{\frac{1}{2}} / L^{\frac{1}{2}}) \\ (M^{\frac{1}{2}} L / T^{\frac{1}{2}} + T^{\frac{1}{2}} / L^{\frac{1}{2}}) & (b - \mu^{\frac{1}{2}}) \end{vmatrix} = O$$

is true.

Of the second set of theories, since they cannot be understood physically, at present at least, it is unnecessary to speak.

I might mention that it would be highly advisable to examine the magnetic properties of helium and argon, as from their position among the elements we might expect that, if there be any substances capable of carrying a true magnetic current, it should be these.

Long-Distance Electrical Power in Sacramento.

According to a press despatch from Sacramento, Cal., current was turned on for the first time on Dec. 23 on the long-distance transmission line of the "Central Electric Company." The line connects Newcastle with Sacramento, a distance of 30 miles. A current of 15,000 volts was, the despatch states, thrown on at the Newcastle power-house to test the line, and the latter was found to be in perfect condition its entire length. The current will be utilized for lighting the city.

Röntgen Rays as a Medical Aid.

BY W. M. STINE.

The aid which Röntgen rays may render to surgical practice has been apparent from their first announcement, and this has been abundently confirmed by a volume of reliable literature and pictorial productions. At the same time it was regarded as problematical whether these rays would prove of value for therapy and diagnosis. These lines being less showy and requiring, moreover, patient and painstaking work, joined to a thorough working knowledge of anatomy, have elicited but little reliable literature. The field is indeed a difficult one to cultivate, and one from which most Röntgen-ray investigators are debarred by reason of scant medical knowledge, while the physicians are equally debarred by lack of skill and knowledge in physical manipulations. Many physicians seem to avoid the subject, due in part to the well-known conservative tendencies and strong prejudices of this profession and in part to the fear that it may have in it an element of quackery.

Whether or not this new field is one which will yield an ultimate rich harvest can only be determined after the results of long and patient observation and experiment are collected. Probably no one at present is justified in making strong claims in anticipation ; what can be said and should be insisted upon is that a field so inviting and promising should be cultivated with the greatest care and diligence, and that conclusions should be withheld until repeated experiments have demonstrated value or uncertainty.

The writer wishes to record here only the results of arduous investigation carried on for the past seven months. In this he has been assisted by a number of competent physicians and surgeons of Chicago, and the reasons which lead a layman to record such experiments are the generous interest and warm appreciation which this profession has accorded his labors.

After all that has been communicated to the technical press by the writer and others on the subject of Röntgen tubes, only a brief allusion is here needed. The work has been done by use of two types of tubes, the pear-shaped or glass, impact type, and the well-known focusing or platinum impact variety. Both types have their uses, and while the first lacks somewhat in definition, its power of penetration, and in some cases of differentiation, are not excelled by the other; besides they are far safer in use.

The diagnostic purposes for value of the Röntgen ray depends not alone on its power of penetration, but rather on a peculiar property of differential absorption. This property is a most singular one, and will of itself demand much investigation. A generalization here seems warranted ; the normal tissues of the body, with the exception notably of the heart and diaphragm, do not cast differential shadows, while tissues which have become pathological in function and structure do so to a notable extent. The causes of this selective absorption have scarcely received any demonstration and can only be surmised. They may be due to pigments, chemical compounds, stratification of the fibres, or the infiltration of liquids. There is but little to guide here; only experiment can avail. One of the most singular instances of selective absorption is found in the pigmental epithelium of the areola of the breast; that this should cause a well-defined shadow when the muscular walls of the chest and aorta do not.

An attempt has been made to explain selective absorption by referring it to the action of the halogens, chlorine, bromine and iodine, also to the proportion of iron in the blood; also the alkaline metals; that compounds of carbon, hydrogen, oxygen and nitrogen have little absorptive power[1]. Only further investigation can decide such questions The fact is that such absorption does exist and on it are based the results noted.

For diagnostic purposes the fluoroscope is by far preferable to the sciagraphic print, and this for reasons best appreciated by the experimenter. The screen best adapted is that having the least phosphorescence. In the use of the screen very much depends on the skill of the manipulator, for shadows become visible or are best defined only under certain relative positions of the tube, patient and fluoroscope. Though the ray readily penetrates clothing, yet the fluoroscope should be brought as near as possible to the object under inspection, and in general, clothing interferes with this; each seam, especially if of starched material, introduces slight shadow lines.

Popular interest attaches to the beating of the heart, clearly depicted in shadow outlines on the screen. The ventricular action is usually watched with ease, but the auricular movement can be

[1] Dr. E. Schrwald in *Deutsche Med. Wochenschrift*, July 23, 1896.

observed as well. A very interesting experiment is to feel the pulse while watching the beat of the heart. This affords another means for measuring the speed transmission of the pulse waves. It is possible that our physiologists may now find occasion to revise the character and succession of events in the heart-beat. This applies especially to the very marked longitudinal shortening of the heart in its systole. The "suction pump" action of the heart in diastole is clearly marked. A great difference in persons exists in the density of the shadow cast by the heart. But this is in all cases so dense that it is very doubtful if it will aid in diagnosing its tissue changes.

It is very interesting indeed to examine the stomach. When in normal condition its outline is barely visible, but if inflamed throughout it is very clearly delineated. If the inflammation is local, such spots are clearly visible. The condition of the stomach can be easily followed by repeated examinations of the patient. One particularly interesting case showed an inflamed state about the cardiac end of the lesser curvature, while at the same time the entire pyloric end seemed involved.

The liver is another organ which in health can scarcely be outlined. In a few cases a diseased condition has been detected and localized. Just how great an assistance such indications will afford the physician remains to be determined, It is probable that only long experience, connected with *post-mortem* examinations, can enable a diagnosis of the character of the diseases of the liver to be determined by the ray.

The spleen is an organ which is as uncertain in physical diagnosis as its physiological functions are unknown. In this particular case the ray promises to be of great value. When the spleen becomes enlarged it casts a well-defined shadow, providing the tube be so placed as to bring the spleen below the heavy curved fold of the diaphragm. In this same connection the kidneys are equally invisible when sound, and cast dark shadows when diseased.

Another item of great interest to physicians is the behavior of tumors, of fibroid and cancerous character, under the ray. The writer regrets he has so far been unable to enter upon this character of work, but is now preparing to examine such growths with great thoroughness. Some investigators have already reported the most encouraging results.

Though work in the abdominal region has been encouraging, that in the thorax has met with marked success. Examinations of the lungs are not only made with comparative ease, but seemingly with great certainty. Tubercular infiltrations and changes in the lung tissue are seen with surprising clearness and located with certainty. The diagnosis of such diseases by percussion are made by the skilled physician with satisfaction, but how greatly is this enhanced when the ray enables the affected areas to be clearly seen! But the ray can do more than this—it can indicate disease too slight for percussion to detect, and the progress of the treatment can be clearly watched. In this connection the most surprising fact is that such slight changes in such delicate tissue can show differential shadows through the heavy muscular coats of the chest wall. In quite a number of cases the cicatricial tissue resulting from pneumonia has been in clear evidence, and this, too, as long as four and five years after the recovery.

In the light of the results so far obtained it is probable that the greatest benefit of the ray will result from its diagnostic value in certain obscure cases involving the lymphatic glands. My attention was early called to this by a most interesting case. The patient had been diagnosed several times and reported to have disease of the lungs. The only physical events were a persistent, peculiar cough and a pronounced anæmic condition, an enlarged thyroid gland, and a slight enlargement of a chain of glands in the neck. An examination by the ray showed complete transparency of the lungs and no indication of disease there. But the deep-seated chain of glands lying near the aorta showed marked enlargement between the third and fifth ribs. On the left side some of the superficial glands were opaque. The physician in charge could find no direct evidence of tuberculosis. A treatment indicated by such facts was accordingly prescribed and a very marked improvement of the patient has resulted. The course of the treatment has been watched by frequent examinations, and the swelling of the superficial glands has entirely subsided, while the deep-seated ones have shown a marked decrease. These diagnostic results have been clearly confirmed by two additional cases. It has also been discovered that an anæmic condition is more frequently accompanied by a glandular disturbance than has heretofore been suspected.

Briefly, an inflamed periosteum resulting from bruise is clearly seen, and strains of muscle and tendon show on the screen by darkened lines.

When discussing the therapy of the ray, one enters on dangerous grounds, but this has been carefully tested in tuberculosis of the lungs, and the results are worthy of record. Marked improvement has followed the mild and continued application of the ray from glass impact tubes. Venturing an opinion here, experimental evidence seems to point to the conclusion that the ray is simply tonic rather than chemical in its action; that its effect on the white corpuscles is especially marked, toning them and possibly increasing proliferation. There is also evidence that this action should be distinguished from the morbid atonic proliferation found in leucæmia.[1] But these lines demand experiment rather than discussion.

A word of caution must be given experimenters when using the focus tubes. Such tubes inflame and tan the skin, and no exposure should last over 10 or 15 minutes. Much erroneous matter has been written on this subject. It is pretty certain that such effects on the skin are not due to ozone nor oxides of nitrogen. With the earlier form of tubes, when exposures were prolonged, and ozone most abundantly produced, no such effects were noted. The tanning is in all probability due to ultra violet rays, associated with the production of Röntgen rays. An occurrence in the writer's laboratory may be given in argument. An experimenter was piercing a heavy iron casting with an electric arc, using a high current. The eyes were shielded from the light by colored glasses, but not the face. The exposure lasted about 3 minutes. Subsequently the experimenter's face became tanned and inflamed, and the skin peeled off. The electrostatic charge from the Röntgen tube may have some effect in drying the skin, but even this appears doubtful. As for non-healing sores resulting from the ray, this again is due rather to the condition of the patient. With such conditions present, given any cause for inflammation and the result will be the same. Powerful Röntgen tubes should always be applied with caution.

The Heating of Magnet Coils.

BY HENRY S. CARHART.

Since the outside of the coil is usually exposed to the air and the inner layers give up heat to the core, it is evident that the region of highest temperature must lie somewhere in the interior of the coil. Obviously a practical method of obtaining the curve of temperature from the interior to the exterior of the coil by means of as many points as there are layers of wire, if desirable, is to wind in appropriate thermal couples. After calibration they form a reliable means of getting the temperature at the points where they are placed. The data for this paper, obtained by the employment of German silver-iron couples, were secured by two of my students in electrical engineering, Messrs. Soper and Caldwell. The investigation involved a large amount of labor; it is on that account somewhat less complete than I have found desirable as a basis of satisfactory generalization.

The two chief deductions are: First, the emissivity from the unvarnished exterior of the coils; and second, an empirical formula for calculating the maximum temperature inside a coil.

The thermo-electric couples were made of No. 28 wire, and were placed within the coils midway between the ends. One couple was placed next to the core and the others at equal intervals toward the surface. The other junctions were placed in small test tubes filled with kerosene and held in holes bored through the wooden cover of a glass jar. The jar was filled with water containing melting ice. By means of mercury cups the several couples could be connected in succession with the galvanometer.

Coil No. 2 was wound with No. 18 single cotton-covered copper wire on a brass spool 3/32 inch thick. The dimensions were as follows:

Inside diameter, 1.68 inches.
Outside diameter, 3.42 inches.
Length of coil, 3.4 inches.
Number of layers, 22.

Observations were made both with a wooden core and with an iron one, each with three different current densities. To save time a large current was first sent through the coil till it became hot; the current was then reduced to the desired value and was continued till the temperatures were apparently stationary before readings were taken. Figs. 1 and 2 show the results for the wood and iron cores respectively. The effect of introducing the iron core is to throw the point of highest temperature further from the core. In Fig. 2 it is very nearly midway between the core and the outer surface, while in Fig. 1 it is nearer the core. When the iron core was attached to the yoke of the motor magnet to which it belonged the point of maxi-

[1] THE ELECTRICAL WORLD, Dec. 19, 1896, p. 748.

mum temperature was still nearer the surface of the coil, but the form of the curve remained substantially the same.

To obtain from the observed data a working value of the emissivity from the surface the following method has been applied. It is evident that the heat flows from the region of highest temperature both toward the core and toward the surface. It is assumed here that all the heat generated outside the surface separating the regions in which the flow of heat is in opposite directions is lost by radiation and convection from the surface of the coil of wire. It is required to estimate the fraction of the whole heat which flows toward the surface:

Let r_1 be the inner radius of the coil, r_2 the outer radius, and r' the radius of highest temperature. The last is obtained from the curves. Then $(r_2 - r_1)/N$ is the thickness of a single layer of wire, if N is the whole number of layers; and $(r_2 - r')/(r_2 - r_1)\,N$ is the number of layers n outside the radius r'. Let E be the potential difference between the terminals of the coil, I the current, and x the watts lost at the surface. Then

$$\frac{x}{EI} = \frac{2\pi\tfrac{1}{2}(r_2 + r')}{2\pi\tfrac{1}{2}(r_2 + r_1)} \cdot \frac{nI^2}{NI^2} = \frac{r_2 + r'}{r_2 + r_1} \cdot \frac{n}{N}.$$

Substituting the value of n above and

$$x = \frac{r_2 - r'}{r_2 - r_1} \cdot \frac{r_2 + r'}{r_2 + r_1} \cdot EI.$$

then the emissivity e is found from the equation

$$e = \frac{x}{2\pi r l (T - t)},$$

where T is the temperature of the outside of the coil and t that of the air. This formula assumes Newton's law of cooling. It is known to fail for large temperature differences, but it is sufficiently exact for practical applications where the data are necessarily subject to considerable modifications due to shape of coil, size of core, etc. The

TABLE I.

Core.	Amp's.	Volts.	Watts.	r' in Inches.	x	$\frac{x}{EI}$	$\frac{r' - r_1}{r_2 - r_1}$	$T - t$	e
Wood	1.00	8.60	8.60	1 21	5 50	0.64	0.455	16.9	0.00891
"	1.49	15.0	22.35	1.21	14 31	0 64	0 452	52.5	0.00746
"	1 89	21 5	40 6	1.21	25 98	0.64	0.455	85.3	0.00833
									Mean 0.00823
Iron	0.95	8.6	8.20	1.25	4.92	0 60	0.497	18.7	0.00720
"	1.42	13 6	19.31	1.26	11 31	0 59	0.510	41.1	0.00740
"	1 97	13.6	42.16	1.25	25.17	0.60	0 490	73.8	0.00933
									Mean 0.00798

ratio $(r' - r_1)/(r_2 - r_1)$ expresses the fraction of the depth of the

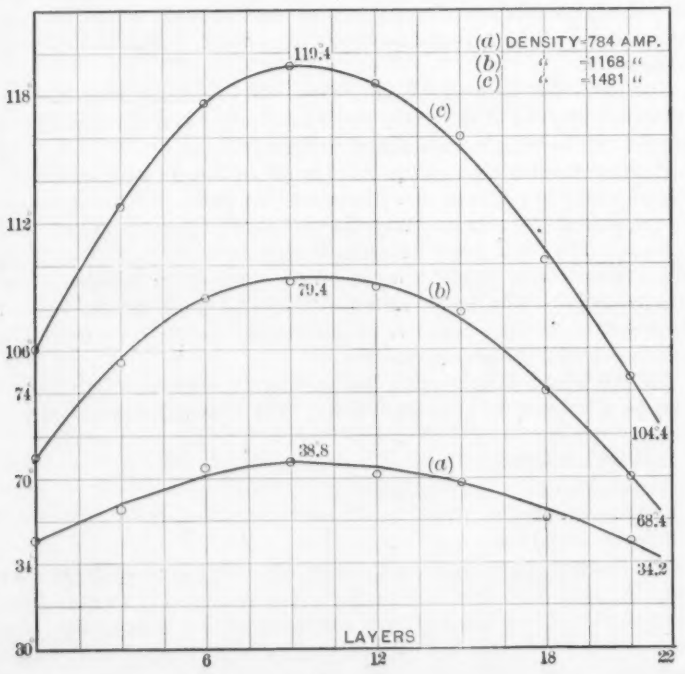


Fig. 1.

coil within the highest temperature. It is useful in obtaining r' from the curves. The value of the temperature T obtained directly from the curves did not usually agree with that obtained by laying the bulb of a thermometer on the coil and covering it with cotton waste. This procedure modifies the distribution of the heat in and about the area covered. The difference, however, is small.

The accompanying table gives the results for the coil from which Figs. 1 and 2 were obtained.

The mean value of the emissivity e, or the watts lost per square inch for one degree C., is for the two cases 0.0081. This value is nearly the same as that of Forbes, 0.00806. But the important fact to which attention should be directed is that the heat emitted from

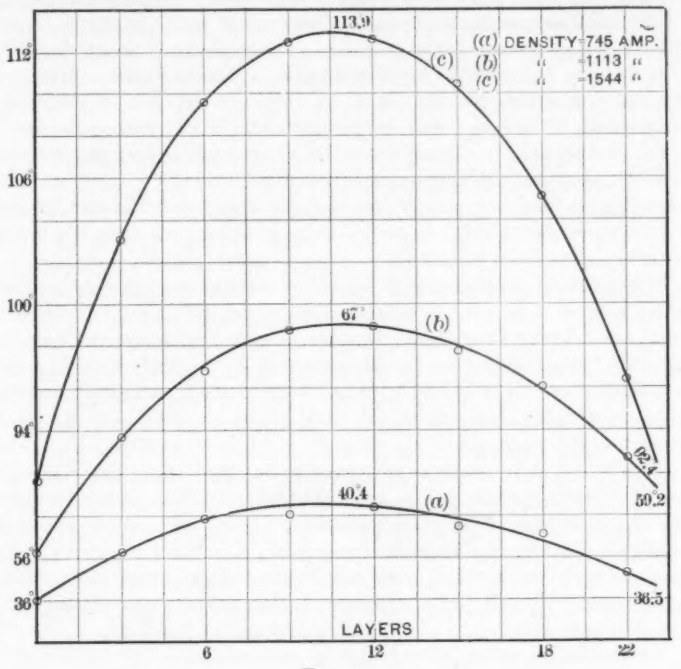


Fig. 2.

the outside of the coil is only from 60 to 65 per cent. of the entire energy converted into heat in the coil. A number of other coils wound with No. 16 wire to various depths on different spools gave approximately the same result. With shallow coils the fraction is usually somewhat larger. For a temperature difference of 40 degrees C., each square inch of surface disposes of 0.325 watt. Practice dictates that no more than 0.4 watt per square inch should be allowed. But the Table I. shows that the coefficient 0.0081 covers only about 65 per cent of the energy converted into heat in the coil, the remainder going to the core for distribution. In other words, an emissivity coefficient of 0.0125 instead of 0 0081 may be allowed in determining the heat disposed of if it is all assumed to go by way of the surface of the coil. This is equivalent to about 0.002 watt per square centimetre. Esson allows 1/355 watt per square centimetre of surface for ordinary varnished coils. This gives for the elevation of temperature outside t^0 (C.) $= 355\,\frac{w}{s}$, where w is the watts converted into heat in the coil and s, its surface, in square centimetres. The above value for the emissivity gives t^0 (C.) $= 500\,\frac{w}{s}$. For the Fahrenheit scale the numerical coefficients are 100 and 140 respectively.

I have endeavored by a process of induction to obtain a working formula to express the *maximum temperature* of the coil in terms of known quantities. A study of the observations shows that for a given coil the highest elevation of temperature of the coil above the surrounding air is proportional to the square of the current density. But since the internal elevation of temperature increases with the depth of the coil, the constant in the relation should be conditioned on the depth of the coil. The following empirical formula gives the highest temperature T_1 in centigrade degrees when the depth of the coil is not much less than three quarters of an inch:

$$T_1 = t + 0.0000445 \times d^2 \times D,$$

where t is the temperature of the air, d the current density, and D the depth of the coil in inches. The formula applies to coils with iron cores in still air, not subject to the action of an armature as a blower. Whether the wire is single-covered or double appears to make little or no difference.

It is quite likely that the constant in the equation for maximum temperature may be changed by data derived from larger coils on commercial dynamos, but the equation as it is will serve to give a good approximation by calculation to the highest temperature which may be anticipated.

Theories of the Jacques Cell.

BY C. J. REED.

DURING the past year the usual number of new processes for obtaining "electricity direct from coal" have appeared. Most of them, being founded on the mistaken idea that the carbon was oxidized, when in reality it only acted as a conductor, easily relegate themselves to their proper sphere. The commercially important question is not whether the transformation is direct or indirect, provided it admits of an economical application. The commercial value of any process depends upon two factors: first, the theoretical limitations as to possible efficiency, or the cost of fuel; second, the convenience of the process and the expense incident to its practical working. The first of these questions, naturally preceding the other, is the one which at the present time commands most attention.

The great aim has always been to find a process having greater theoretical possibilities than the thermo-dynamic. The only process evolved during the past year that has been tried on any scale approaching commercial magnitude is that of Dr. W. W. Jacques, of Boston. The same process, but operated by a different electrolyte, *viz.*, lead oxide, was patented to Sidney H. Short, of Cleveland, Oct. 13, 1896. but no details of its operation have been published. This same process was also applied with another electrolyte about 20 years ago by Jablochkoff (see *Comptes Rendus*, Dec. 3, 1877), who used the same arrangement as Jacques, with the substitution of an alkaline nitrate in place of the alkaline hydrate, and he obtained from two to three volts.

From the data published by Dr. Jacques, in *Harper's New Monthly Magazine*, December, 1896,[1] showing a total efficiency of 32 per cent., it is apparent that the energy is not derived entirely from the external heat. The energy of the carbon within the cell must have contributed, in a large part at least, to the development of electrical energy. Its oxidation must be explained on the theory of either galvanic or electrolytic action. We shall examine the possibilities of the cell on each of these theories.

In order to establish either galvanic or electrolytic action, the chemical reagents that undergo oxidation and reduction must each constitute a link in the closed chain of electric conductors that make up the circuit. Galvanic action can occur only when a path is provided for the escape of electrical energy through the substance of the chemical reagents, one being electro-positive, the other electro-negative. Electrolytic action can take place only when a current can pass through the electrolyte. The idea that galvanic action can take place between oxygen in the gaseous state and carbon, is no more to be conceived than that of a galvanic battery consisting of zinc and air.

The oxygen necessary to oxidize the carbon in the Jacques battery, must, as in all other galvanic and electrolytic cells, come from the electrolyte. This much is clearly admitted by Dr. Jacques, who states it as a new principle in science and claims to be its discoverer, though, as a matter of fact, it was established beyond question by the electro-chemical researches of Faraday, Daniell, Matteucci and Becquerel and has been generally recognized for at least half a century.

The difference between galvanic and electrolytic action depends solely upon whether the sum of the reactions that take place in the electric circuit and between the terminals of the cell results in an absorption or an evolution of energy. Where the action is galvanic the sum of the chemical changes alone is exothermic and the action spontaneous, no application of external energy being required to start or maintain the reaction. In electrolytic action, the sum of the chemical changes and transformations that take place in the electric circuit and between the terminals of the cell is either athermal or endothermic, and the action is never spontaneous, but always requires the assistance of an electric current for its inception or continuance.

To illustrate this difference we may take the passage of an electric current from a dynamo through a solution of copper sulphate between copper electrodes. For each equivalent of copper that is oxidized at the anode its energy of 55.6 units is all converted without loss into electrical energy and added to that of the circuit, while an equal amount of energy passes out of the circuit at the cathode and is absorbed in reducing an equivalent of copper, no heat being generated, except what is produced in overcoming the resistance of the cell. This heat is evidently not due to the oxidation of the copper, but comes from the electric current, and since this heat must all be supplied by the dynamo the action is electrolytic. If we substitute a zinc anode for the copper anode and by suitable means provide against local action, we have, for each equivalent of zinc oxidized 108.8 units, or all the energy of the zinc added as electrical energy directly to the circuit. At the cathode we have as before, the reduction of an equivalent of copper and the absorption of 55.6 units from the circuit, the difference, $108.8 - 55.6 = 53.2$ units, being the net amount added to the circuit. This is equivalent to

$$\frac{53.2}{2 \times 23.26} = 1.14 \text{ volts.}$$

If the resistance of the cell is very small compared to the total external resistance this E. M. F. will be added to that of the external circuit in overcoming the external resistance, and will be apparent at the terminals of the cells. The cell now evolves electrical energy and its action is galvanic. If the external resistance be diminished until the ratio of the total external to the internal resistance is equal to the ratio of the external E. M. F. to 1.14 volts, the apparent E. M. F. at the terminals of the cell become zero. The 108.8 units of energy are still being added to the circuit for each equivalent of zinc oxidized and 55.6 units are being absorbed from the circuit by the reduction of the copper. In overcoming the resistance of the cell 53.2 units (also absorbed from the circuit) are converted into heat. In other words, the cell is adding to and absorbing from the circuit equal amounts of energy. The action could not take place through any external resistance without the assistance of external energy and is electrolytic. If the external resistance be still further reduced, the E. M. F. added to the circuit by the 53.2 units is less than that required to overcome the resistance of the cell, and the additional E. M. F. from the dynamo reverses the apparent polarity of the cell. The cell is now absorbing from the circuit more electrical energy than it has added to the circuit, and the action is electrolytic. In none of these cases is the chemical energy of the oxidized substance, either by galvanic or electrolytic action, degraded into heat in the process of becoming electrical energy. Any heat that may appear in the electrolyte originates in previously existing electrical energy, not in the heat of chemical action. The electrolytic transformation of chemical into electrical energy cannot, therefore, come under the limitations of thermo-dynamics, but, like the conversion of other forms of energy into heat, is without loss. The only tenable galvanic or electrolytic theory for the Jacques cell is that the fused electrolyte acts as a solvent on the carbon in a manner similar to the solvent action of various solutions upon zinc in ordinary galvanic batteries.

The only possible constituents of the electrolyte in the Jacques battery are:

Potassium hydrate	KOH
Ferrous oxide	FeO
Ferric oxide	Fe_2O_3
Potassium ferrate	K_2FeO_4
Iron	Fe
Impurities.	

None of these substances absorb oxygen in solution as water does, though iron and its lower oxides, heated to a red heat in potassium hydrate, combines chemically with oxygen to form potassium ferrate. The only oxygen, therefore, that can be utilized in this cell for the oxidation of carbon, either by galvanic or electrolyctic action, must be derived from the decomposition of some constituent of the electrolyte. This can take place only by the reduction of one of the above-mentioned substances.

Prof. Elihu Thomson[2] has observed that the action of the Jacques cell does result in the reduction of an oxide of iron to the metallic state, and that the function of the oxygen is to re-oxidize this iron—in other words, to regenerate the "depolarizer." The electrolyte acts therefore as a solvent for the carbon, exactly as an oxidizing saline or acid solution acts as a solvent for zinc or copper. Whether the action is electrolytic or galvanic may then be determined, if we know the chemical reactions and their thermal equations.

The formation heats of the substances concerned are as follows:

		Kilo. heat units.
Carbon dioxide	CO_2	97.
Water	H_2O	69.
Potassium hydrate	KOH	104.3
Ferrous oxide	FeO	68.2
Ferric oxide	Fe_2O_3	191.2
Potassium ferrate	K_2OFeO_3	

[1] See *Digest* of THE ELECTRICAL WORLD, Dec. 5, 1896.

[2] See *Digest* of THE ELECTRICAL WORLD, Nov. 28, 1896.

On the supposition that potassium is reduced, the reaction is:

$$\left\{\begin{matrix}4KOH\\417.2\end{matrix}\right\} + C - 182.2 = \left\{\begin{matrix}CO_2\\97\end{matrix}\right\} + \left\{\begin{matrix}2H_2O\\138\end{matrix}\right\} + 4K.$$

The reaction cannot occur without the absorption of 182.2 units of energy from an external source, or the application of an external E. M. F. of $\frac{182.2}{4 \times 23.26} = 1.96$ volts. This action could take place only by electrolytic action.

On the supposition that hydrogen is reduced the reaction is (admitting that there is some water present in an uncombined condition),

$$\left\{\begin{matrix}2H_2O\\138\end{matrix}\right\} + C - 41.0 = \left\{\begin{matrix}CO_2\\97\end{matrix}\right\} + 4H.$$

This reaction also cannot occur without the absorption of 41 units of energy from an external source, or the application of an external E. M. F. of $\frac{41}{4 \times 23.26} = 0.44$ volt, and is necessarily electrolytic.

On the supposition that iron is reduced from ferrous oxide to the metallic state, the reaction is

$$\left\{\begin{matrix}2\,FeO\\136.4\end{matrix}\right\} + C - 39.4 = \left\{\begin{matrix}CO_2\\97\end{matrix}\right\} + 2\,Fe,$$

corresponding to the absorption of 39.4 units, or an E. M. F. of $\frac{39.4}{4 \times 23.26} = 0.42$ volt, and is electrolytic.

On the supposition that iron is reduced from ferric oxide to metallic iron, the reaction is

$$\left\{\begin{matrix}2\,Fe_2O_3\\382.4\end{matrix}\right\} + 3\,C - 91.4 = \left\{\begin{matrix}3\,CO_2\\291\end{matrix}\right\} + 4\,Fe,$$

corrresponding to the absorption of $\frac{91.4}{3} = 30.5$ units, or an E. M. F. of $\frac{30.5}{4 \times 23.26} = 0.33$ volt, and the reaction is electrolytic.

On the supposition that iron is reduced from potassium ferrate to the metallic state the reaction is,

$$2K_2FeO_4 + 3\,C = 3CO_2 + 2K_2O + 2Fe.$$

I am not aware that the formation-heat of potassium ferrate has been determined, and cannot therefore say whether the reaction would absorb or evolve energy—whether it is electrolytic or galvanic.

From the nature of the compound, K_2FeO_4, we may infer that its formation-heat is not much greater than that of Fe_2O_3, and it is probably not much less. Assuming it to be equal to that of Fe_2O_3, the reaction still requires the assistance of 0.33 volt or its equivalent in the form of heat.

Considering therefore only the purely thermo-chemical limitations of this cell, we find that its action must be electrolytic on any supposition except the supposition that the electrolyte is potassium ferrate, and that the formation heat of that substance is less than 145.5, this value making the E. M. F. zero. On this latter supposition the chemical action is exothermic, spontaneous and galvanic. Local action also would be unavoidable, since detached particles of carbon would continue to be dissolved by the potassium ferrate. It is not conceivable that a highly heterogeneous and porous solid, like coke, should be dissolved without mechanical disintegration. The oxidation of detached particles would result in the production of carbon dioxide greatly in excess of that corresponding to the electro-chemical equivalent of the current. If the formation heat of potassium ferrate is greater than 145.5, the action, being endo-thermic, would not take place, except by the absorption of heat or by electrolytic action. In the latter case detached particles of carbon would undergo no oxidation, and the carbon dioxide produced would correspond exactly to the electric current.

If the action is galvanic and the E. M. F. 1.04 volts, as stated by Dr. Jacques, we are driven to the conclusion that the formation-heat of potassium ferrate is exactly zero, a conclusion which we cannot accept without some other proof. Whether this shall prove to be the case or not, it is certain that if the action is galvanic the E. M. F. of this cell does not depend upon the combustion heat of carbon in oxygen gas, but upon the energy evolved or absorbed in the chemical reaction between the carbon and the electrolyte. Until the formation-heat of potassium ferrate is known, the experimental determination of 1.04 volts by Dr. Jacques must be considered one of those remarkable coincidences that frequently occur, where experiment apparently proves with great precision the correctness of predictions previously calculated on an erroneous supposition. If further proof is needed on this point, the reader is referred to the experiments of Jablochkoff, mentioned above, in which a much higher E. M. F. was obtained.

Having considered the electro-chemical possibilities of the Jacques cell, so far as he has made known its contents, we may turn now to its thermo-electric possibilities.

That fused potassium hydrate in contact with an iron pot (from which it is continually receiving heat) and a carbon rod (from which it is receiving no heat) forms a powerful thermo-electric couple, independent of any galvanic action that may be present, is shown in several ways.

1. At low temperatures the carbon is electro-negative to the iron pot; at high temperatures, electro-positive.

2. At temperatures below that at which the electrolyte has any chemical action on carbon, the E. M. F. is considerable, and increases with the temperature to nearly one volt, afterward diminishing to zero and becoming electro-positive, the maximum electro-positive value not being greatly different from its maximum electro-negative value.

3. The substitution of an iron rod for the carbon gives substantially the same result, the E. M. F. being as high as 1.15 volts, an effect that cannot be explained by galvanic action.

4. Substantially the same results as to E. M. F. may be obtained with a stream of illuminating gas passing into the electrolyte and completely excluding oxygen from the cell.

A thermo-electric current, like any other electric current, in passing through the electrolyte would necessarily cause oxidation of the carbon (or evolution of free oxygen) and reduction of the most easily reduced constituent of the electrolyte in electrochemically equivalent proportions. The experiments of Jacques show that the carbon dioxide is formed in equivalent proportions, and those of Thomson show that iron is reduced.

By electrolytic action all of the chemical energy of the carbon would be added directly to the energy of the electric circuit with an efficiency of 100 per cent. A part at least, if not all, of the energy required to reduce the iron may be supplied by the absorption of external heat by a purely thermo-chemical reaction, the efficiency of which is not subject to the limitations of thermo-dynamics; since in a thermo-chemical change of this kind there is absorption without rejection of heat. It is by the same process that it is possible to reduce iron by carbon in a blast furnace, the energy of the carbon alone being insufficient to accomplish the reduction. A total efficiency of 32 per cent. in a thermo-chemical reaction of this kind is not only possible, but has been exceeded in practice.

It is also to be considered that, as a thermo-electric couple, this cell differs in an important particular from thermo-electric junctions between metals. In metallic couples the efficiency is limited by the second law of thermo-dynamics, because the only source of heat is the difference between the heat received from without and the heat which is again rejected. But in the case of the Jacques cell we have the peculiar circumstance that oxidation of iron is going on within the hot junction, and the resulting heat (which is greater than that obtainable from the combustion of an equivalent of carbon) is actually evolved within the hot junction, instead of being absorbed from without. What becomes of this heat? It certainly does not escape, and it is sufficient to raise the temperature of the hot junction far above that required to give a possible efficiency of 32 per cent. This heat is also exactly equal to that required by the reduction of another equivalent of iron to the metallic state. There is no apparent reason for denying that an equivalent of metallic iron may be oxidizing and giving up its heat to the hot junction, while an equivalent of ferrate is being reduced with absorption and transformation of this energy at the cold junction, especially since it has been found that metallic iron is being constantly oxidized in contact with the cell wall. The combustion heat of this iron amounts to 1.27 times the energy of the carbon consumed in the cell, and to 84.5 per cent. of the heat evolved on the grate, according to the figures given by Dr. Jacques.

On this theory, that the heat evolved by the oxidation of metallic iron in the hot junction is transformed at the cold junction into chemical energy in reducing iron, the electrolytic oxidation of the carbon would add all its energy to that of the electric circuit without loss of any kind, as in all other electrolytic oxidations. This would

account exactly for the 1.04 volts obtained by Dr. Jacques and seems to be the only way in which it can be accounted for. The validity of this theory is also entirely independent of the value of the formation-heat of potassium ferrate.

Some of the statements made by Dr. Jacques, which were evidently intended to establish the galvanic theory, are not stated definitely enough to be convincing, and the details and conditions of his experiments are not given. In stating that the action is proved to be not thermo-electric by an experiment in which he maintained all the parts of the apparatus at the same temperature, he gives no details to show that such was the case. It is not clear how he did this without either discontinuing the current of air or heating it before its introduction into the cell to the exact temperature of the cell. If the air was previously heated to the temperature of the cell, how did he prevent the formation of great heat and high temperature by the oxidation of reduced iron at the cell wall? How he accomplished all these requirements and how he measured the temperature of different parts of the cell were not stated.

The favorable results obtained by the use of platinum apparatus is easily accounted for, potassium hydrate acting on platinum at high temperatures exactly as it acts on iron, forming a potassium platinite. In regard to apparatus of gold and silver we are again disappointed by infiniteness. He merely says: "Gold and silver gave good results, but inferior to platinum." If the E. M. F. were due to the combustion of carbon in oxygen, as stated by Dr. Jacques, it would make no difference whether the apparatus were of iron, platinum or silver.

On the theory of electrolytic action supplemented by thermochemical reactions, as outlined above, no considerable amount of electrical energy, if any, would be obtained by using pure alkaline hydrate and an apparatus of material unaffected by the hydrate. Experiments of this kind will doubtless be made in due time, which will enable us to arrive at a more positive conclusion.

The High-Tension Accumulator of the Jefferson Physical Laboratory of Harvard University.

BY JOHN TROWBRIDGE.

A high-tension accumulator of 500 cells, which I saw in the experimental laboratory of the American Bell Telephone Company, led me to decide upon the construction of a much larger one of the same type. My object was to secure a steady source of electricity for the study of the discharges of electricity through gases, in order to trace the character of these discharges from their first manifestations to the point of development of the Röntgen rays. A steady source of electricity is evidently highly desirable, and a source also which can be varied readily and accurately in respect to the E. M. F. and quantity of current. The ordinary induction coil is an extremely variable source of electricity, for the irregularities of the break are great; and the reactionary effort of the secondary on the primary, the presence of iron in the primary, and the to-and-fro nature of the discharges tend to confuse the phenomena to a great extent. Step-up transformers with Thomson and Tesla coils are open to the objection that a to-and-fro current is necessarily employed. The alternating nature of this current makes it impossible to separate the effects which arise at the anode from those which spring from the cathode. An electrical machine has a varying capacity, is controlled with difficulty and often reverses unexpectedly. A storage battery is free from all these defects, and can furnish a practically steady source of electricity for several hours.

De la Rue and Miller constructed a primary battery consisting of 15000 chloride of silver cells. This battery, however, had all the defects of chemical batteries; it was inconstant and required constant attention. In the present state of the subject no one would think of setting up a chemical battery. In Germany various investigators have employed from 600 to 1200 Planté cells for the investigation of the discharge of electricity through gases. In the *Annalen der Physik und Chemie*, No. 11, 1896, Prof. Quincke, of Heidelberg, deems the construction of a high-tension accumulator of so much importance that he devotes five pages of his article to an account of the details of the accumulator. He employs 1200 Planté cells. I have had in use 5000 and expect in two or three weeks to have 10,000 in action.

Each cell consists of a test tube five inches long and an internal diameter of about one inch. The strips of lead are insulated from each other by rubber bands and do not extend to the bottom of the test tubes. Three of such tubes are mounted in blocks of wood which have been boiled in paraffin, and the blocks are placed on suitable shelves in cases. Each case contains about 400 cells. The cells can be placed in parallel or in series by suitable switches, which are on the back of the cases. Each can be used alone or in suitable combination with the other cases.

The shock from even one case is very disagreeable, and I believe it is dangerous, for after having received it one is unable to collect one's ideas for a moment, and the remembrance of the shock lasts for several hours. An experience with such a shock leads the operator to keep one hand in his pocket and to clothe the other in a rubber glove while he is changing the switches. When the cells are well formed it is evident that they will give considerable quantity of electricity, as well as a high tension. This is shown by the character of the spark, which is exactly like that obtained by a step-up transformer—a flaming, forked discharger threaded by white sparks. By drawing the spark terminals apart the flaming discharge follows the terminals for a space of at least six inches. The discharge of the entire battery I believe would be deadly. The action of the battery shows very clearly what takes place in starting the ordinary arc lamp. A small spark first breaks down the resistance of the air, and then the arc is set up. A difference of potential of about 10,000 cells is sufficient to cause a spark in air between pointed terminals about three fourths of an inch apart. When Leyden jars are connected to the terminals of the battery they can be rapidly charged and discharged through a suitable spark gap. The spark with about 500 electrostatic units appears to the eye to be continuous; but when it is examined by a mirror revolving slowly it is seen to be intermittent. The note emitted by the spark is also proof of this intermittance.

It is evident that this battery affords a convenient means of studying the strength of various insulators under the stress of steadily increasing values of E. M. F. It can also give a constant field of electric force for many experiments in which this is indispensable. Prof. Quincke employed his battery for this latter purpose. In the discharge of the battery, however, through rarefied gases the battery reveals the most interesting phenomena. To those who have had the trying experience of using an induction coil in connection with a spectroscope, the employment of a high-tension battery is a great pleasure.

One can study the discharge of electricity through rarefied media for hours, unhampered by the fitful action of mechanical breaks and the uncertain action of the coils. It is necessary in using a battery of the magnitude I employ to send the current through a liquid resistance of many thousand ohms before it is sent through a Geissler tube. Without resistance the tube is immediately shattered by the intense heat which is evolved.

Prof. Theodore William Richards and I have examined the spectra of the new gas, argon, by means of this battery and have discovered that this element, although chemically very inert, exhibits a remarkable sensitiveness to an electrical stimulus. Thus in the form of rarefied gas at a definite pressure it changes from a red tint to a vivid blue tint when oscillatory electrical discharges are passed through it. A small amount of impedance in the circuit is sufficient to change the tint of the discharges through the gas. When a tube filled with argon is held near a Hertzian oscillator it shows the blue tint, when the oscillator is sending forth waves, and the red tint when the oscillator is under the influence of unidirectional discharges, and is not sending forth waves. We have called a tube filled with argon at about one millimetre pressure a talantoscope (from the Greek word *ταλάντῶσις*, oscillation).

We have also examined other gases and have discovered a remarkable series of multiple spectra, which are dependent upon the electrical conditions of the circuit—that is, upon the E. M. F., the impedance and the capacity of the circuit. One can, so to speak, play upon the gas through the intervention of self-induction resistance and capacity, and evoke as many spectra as there are changing electrical conditions.

A battery of 5000 cells, however, giving 10,000 volts is not able to excite the Röntgen rays in a Crookes tube. Ten thousand volts seems to be the lower limit at which the Röntgen rays fail to appear or to be just on the point of appearing. When a Crookes tube is strongly heated in a Bunsen burner the discharge from a battery of 5000 cells dimly lights up the tube. Then the light rapidly grows stronger and finally the tube is filled with a dazzling white light and the tube bursts. No Röntgen rays, however, can be perceived even when the light in the tube is very brilliant. With 10,000 cells giving 20,000 volts it is probable that the Röntgen-rays can be excited in the tubes.

Progress in American Telegraphy.

BY F. W. JONES.

IT is only the very oldest inhabitant who was active in commercial affairs in the United States 53 years ago that can even inadequately appreciate the difference, then and now, in the facilities for the interchange of intelligence between separated places. If we get time in this workaday age perhaps we may be able in imagination to contrast the situation of the two periods, but in doing so, if we are to have our wonder and admiration keyed up to the proper pitch, we must be at least historically familiar with the general commercial and social condition of the country prior to the introduction of the electric telegraph.

As late as March 10, 1837, the Secretary of the Treasury issued the following circular to "Certain collectors of customs, commanders of revenue cutters and other persons:"

"With the view of obtaining information in regard to the propriety of establishing a system of telegraphs for the United States in compliance with the request contained in the annexed resolution of the House of Representatives, adopted at its last session, I will thank you to furnish the department with your opinion upon the subject. If leisure permits, you would oblige me by pointing out the manner, and the various particulars, in which the system may be rendered most useful to the Government of the United States and the public generally. It would be desirable, if in your power, to present a detailed statement as to the proper points for the location and distance of the stations from each other, with general rules for the regulation of the system, together with your sentiments as to the propriety of connecting it with any existing department of the Government, and some definite idea of the rapidity with which intelligence could ordinarily, and also in urgent cases, be communicated between distant places. I wish you to estimate the probable expense of establishing and supporting telegraphs upon the most approved system, for any given distance, during any specified period.

"It would add to the interest of the subject if you would offer views as to the practicability of uniting, with a system of telegraphs for communication in clear weather and in the daytime, another for communication in fogs, by cannon or otherwise, and in the night by the same mode, or by rockets, fires, etc.

"I shall be gratified by receiving your reply by the 1st of October next."

It will be seen by this circular that the development of a telegraph was looked for in the direction of a visual telegraph system similar to one introduced in France in 1791 by Claude Chappe, or by heliographic apparatus, by which rays of light were directed from one high position to another and words communicated through a prearranged code of signals.

On Sept. 4, 1837, Prof. S. F. B. Morse had perfected a system of telegraphy in which electricity was employed as the agent for carrying signals over a metallic wire between distant points. On that day he had put in operation his crude experimental apparatus in the New York City University, and transmitted over 1700 feet of wire around the walls of his room in that building, the signals necessary, according to a code he had adopted, to represent the following words: "Successful experiment with telegraph Sept. 4, 1837."

In this system, the words in a dictionary were numbered in the margin and the above transmitted words were represented by numerals as follows, Successful, 215; experiment, 36; with, 2; telegraph, 58; September, 112; and so on, and the figures were recorded as follows: Two electric pulsations over the wire, 2; one pulsation, 1; and five pulsations, 5; which were marked on a moving band of paper at the receiving end by a lead pencil attached to the armature of the electric magnet.

It is not difficult to perceive that such a method involving a dictionary of number words in the hands of every operator would be very cumbersome and slow. Nevertheless it was immeasurably in advance of all semaphore or other visual systems the world had ever known. It was on the 2d of September, 1837, that Mr. Alfred Vail, of Morristown, N. J., saw Prof. Morse's apparatus and almost immediately engaged to assist in reducing it to a more practical form. Prof. Morse was also very ably assisted by Prof. Leonard Gale of the University.

The improved apparatus through their joint efforts was completed by Jan. 6, 1838, when it was tested in Morristown, N. J., over two miles of wire transmitting and receiving the following sentence:

"Railway cars just arrived 345 passengers."

The new apparatus consisted of a transmitter designated as a port rule in which metal type were set up representing the numerals which constituted the words according to the prearranged dictionary. The recording instrument was substantially the same as in use to-day, except perhaps it marked by lead pencil or ink instead of embossment.

On Jan. 4, 1838, the new machine was brought to the University in New York City and a test made through 10 miles of wire stretched around the rooms and the following sentence (the first on record ever to have been transmitted by the present Morse dot-and-dash code) was recorded:

"Attention the universe by kingdoms right wheel."

At this time we find the dictionary numeral code, which was used at Morristown 18 days previously, was discarded and the port rule was filled with metal type of dots and dashes grouped to form letters exactly as they are constituted at the present moment, except that the letter "B" was represented by three dots and a dash, and the letter "V" by a dash and three dots.

A few days after the test just mentioned the apparatus was exhibited before the Committee of Science and Arts in the Franklin Institute, Philadelphia, and before the President, cabinet and Committee of Commerce in the Capital at Washington, D. C., Feb. 21, following.

So little faith was placed in the invention of Prof. Morse by either the Government or business men at that time that Prof. Morse had a severe struggle to secure any attention to it, but finally on March 3, 1843, Congress allowed him an appropriation of $30,000 to test the practicability of his telegraph system, and on May 27, 1844, he had two wires up between Washington and Baltimore, and Miss Annie Ellsworth sent from Washington the first message as follows:

"What has God wrought?"

On this occasion the port rule and type were abandoned and the dot-and-dash signals were transmitted by the use of a key which Miss Ellsworth worked by hand to connect and disconnect the electric battery with the wire leading to the register in Baltimore.

Miss Ellsworth was assisted by Prof. Morse and L. F. Zantzinger at the Washington end and Mr. Alfred Vail in Baltimore.

A clear description of the register is given in the report to the Commissioner of Patents on Jan. 1, 1850, by Patent Office Examiner C. G. Page, who says: "When Prof. Morse's telegraph was first essayed in this city (Washington) it recorded the signs upon a moving fillet of paper by means of a pen charged with ink, the pen being supplied from a reservoir or fountain. It was found difficult to regulate the flow of ink, more especially as the motion of the pen was apt to *throw* the ink, as it was termed, and the pen was accordingly dispensed with and a contrivance substituted by which marks corresponding with those made by the pen were indented upon the fillet of paper."

It is very remarkable that this simple telegraph system developed by Morse and his assistants Vale and Gale, in 1844, with substantially no change, should be the universal system in use upon all the land wires of the world after the lapse of 53 years. There is no country to-day so benighted as to be unfamiliar with the sight of telegraph wires, and there are no places so remote to which civilized and commercial centres are not connected, and the miles of wire that are daily tingling with Morse signals may be counted by millions.

On Sept. 9 last, the 50th anniversary of the Belgian telegraph was celebrated in Brussels in a very brilliant manner. An exhibit was made of all the various kinds of telegraph instruments that had been used since the Belgian Government, on Dec. 23, 1845, gave Cooke and Wheatstone, of London, a concession for the first telegraph wire along the railway from Brussels to Antwerp. At the opening of the exhibition Mon. M. J. Banneux, Chief Engineer of the Belgian Postal Department, delivered an interesting address, in which he said: "The Cooke and Wheatstone apparatus required a somewhat long apprenticeship and aptitudes, which are not to be found among lower-grade railway employees. Strong instruments easy to manipulate were required, such as would signal letters and figures without any labor of mental transformation, and would at the same time lend themselves to rapid transmission of messages.

"The dial and letter apparatus of Bréguet, of Paris, and Lippens, of Eccloo, fulfilled these desiderata. These instruments were used together for many years. The Lippens, which was continuously improved, had an existence of 22 years, while the Bréguet only came into use later.

"But the American system of Samuel Morse was destined to progressively dethrone every other. The Morse method presented in

addition to the advantage of easy manipulation that of making durable marks on a strip of paper; these signals, dots and dashes were at first embossed, but in 1856 and 1857 they were written in ink, thanks to Thomas John, an Austrian, and to Beauduin and Digney, of Paris. From that date the Morse apparatus was sufficiently well equipped to conquer the world.

"During the last decade a very interesting phenomenon has been observed. On one hand we have returned to the fugitive signals of the early days, on the other hand, we have increased tremendously the working efficiency of our lines by applying, sometimes to the Morse, sometimes to the Hughes, duplex arrangements which enable us to exchange by a single wire two opposite messages at the same time. The Morse apparatus no longer writes. It sounds. It is no longer the *eye* which intervenes, it is the *ear*. It is the acme of simplicity."

In France, those wonders of electro mechanism, the Hughes, and the Baudot type printing systems, are considerably used in conjunction with the Morse system. The Hughes is capable of being duplexed, the Baudot will transmit up to five messages simultaneously on short lengths of wire.

Over the various circuits in Great Britian and Ireland during the year ending March 31, 1896, there were transmitted 78,839,610 telegrams, of which 5,915,646 press messages were mainly carried by the Wheatstone automatic system, the rest almost entirely by Morse system.

In the United States, with the exception of five or six Wheatstone circuits and two Phelps type-printing circuits, all messages are sent by the Morse system, the messages being received by sound. The quadruplex, made practical by Edison in 1874 and more recently improved by others, is the highest development of Morse apparatus for use on long circuits, and permits the transmission of four messages simultaneously, two in one direction and two in the other. For very long circuits the most efficient Morse system is the duplex, embracing reversing transmitters and polarized relays, admitting of two simultaneous transmissions, one in one direction and one oppositely.

In 1895 the Western Union Telegraph Company and the Postal Telegraph Cable Company transmitted over 72,000,000 messages, including press (reckoning 30 press words to each message), nearly all by the Morse sounder, and by the same method an enormous volume of messages have been sent by railway officials over wires exclusively set apart on every railway for its own use, and also by private firms having leased wires.

The vast telegraph traffic in the principal European countries is shown by the following figures which represent the year 1890: Great Britain and Ireland, 66,500,000; France, 28,000,000; Germany, 26,000,000; Austria, 9,000,000; Italy, 8,000,000; Belgium, 5,300,000; Hungary, 4,500,000; Holland, 4,300,000; Russia, 2,700,000; Switzerland, 1,600,000; Sweden, 1,700,000; Norway, 1,500,000; Denmark, 1,500,000, and Spain, 1,000,000, making a total of 161,600,000 messages and by adding the estimated sum of 70,000,000 for the United States makes a grand total of over 231,000,000 messages transmitted in one year, saying nothing of Canada, Central and South America, and several other large countries that employ the telegraph.

In addition to the telegraph we have the Bell telephone instrument, which was invented by Alexander Graham Bell in 1876, and which in conjunction with the carbon transmitter is employed the world over for the transmission of speech. It is almost entirely used by subscribers to do their telephonic correspondence without calling in the aid of operators, as is done in the use of the telegraph.

It is estimated by the American Bell Telephone Company that in 1894 over 670,000,000 of exchange connections were made in the United States alone to place subscribers *en rapport* with each other.

How the business of the telegraph and telephone shall adjust themselves to each other depends entirely, of course, on the demands of the public, and how the two systems shall accommodate themselves to commercial and social needs. As a matter of fact, they are both telegraph systems, but the telephone lends itself to the use of persons who need have no telegraphic skill, and has a peculiarly useful field of its own; yet the telegraph also possesses advantages which will ensure its extensive and growing use.

Improvements are being constantly made in the machinery and other equipment of telegraph offices, the object being to secure the utmost speed and accuracy in the transmission and delivery of telegrams, and at the same time to render the labor of the employees as agreeable and healthful as possible.

The typewriter is coming into general use, superseding the pen for copying the messages, and more readable copies are thus produced, besides enabling the operator to copy faster and with less physical strain. It may be not far distant when a keyboard Morse code transmitter will have been so far perfected as to displace the present keys and still further add to the ease of the operator, and at the same time furnish signals more perfect than is possible by hand and key.

The wires and pole lines have been gradually improved, and telegrams are less delayed by the effect of storms than ever before. In large cities the wires now are for the most part placed underground, and within the next few years a continued improvement in the overhead structures between cities may be looked for, so that in the not distant future an interruption of communication by storms will be a rare occurrence.

As to what extent automatic machine transmission may come to supersede the hand key work by Morse is not definitely known. A Morse operator can transmit easily 35 messages an hour, and a Wheatstone perforator can prepare about 25 in the same time.

The skill required in each case is nearly equal. It makes no matter how many words can be electrically transmitted over a wire per minute from one continuous tape, the practical working limit of the wire is reached in handling the messages at the sending end.

Indications are, from careful statistics on the subject in the *Telegraph Age* of Dec. 16, 1894, that the maximum traffic capacity is not far from 150 words per minute for ordinary telegrams.

It is true that in England where the Wheatstone system was brought to marvelous perfection that a nominal speed of over 500 words per minute is claimed on short circuits, but in no case has the regular traffic of telegrams ever been done at any such speed, and I am informed that except in press news not 200 words in one direction attained in daily work, and the system is only used occasionally for transmission of ordinary telegrams in case there is a shortage in Morse wires.

The public has become educated up to quick delivery which is only possible by Morse and telephone, and as this class of business requires many wires during the busy hours of the day, there is always a surplus of wires during the evening and nights for press matter and messages of another class. There would then be no necessity for using a Wheatstone system by reason of lack of wires; it would only be because of economy and accuracy in handling the traffic, and it is thought by some that the Morse operators under the circumstances would prove cheaper and perform the service in a more satisfactory manner. The greatest value at present attached to the Wheatstone system is its ability to push a larger number of messages over a wire than is possible by Morse, when an interruption of Morse circuits occurs; but as it is at the expense of quick delivery in this case it is on the "half a loaf better than no bread" principle. As telegraph structures and wires are made more substantial, this value of the automatic system must disappear.

Night work is more expensive than day work by reason of more light and heat being consumed, and shorter hours of labor being demanded.

Every telegram transmitted is chargeable with its proportion of the whole expense involved in the operation of the telegraph system.

This expense is represented mainly by the following items: Management, bookkeepers, electrical engineers, chief operators, traffic managers, operators, battery and dynamo attendants, rents of storehouses, roofs and underground systems, dynamos and batteries for supply of current to operate the wires, rent, light, heat, and janitors for a large number of offices, taxes, insurance, advertising, damage claims, freight, expressage, postage, stationery, supplies, repairs to wires, to furniture, to fixtures and to machinery, messengers to collect and deliver messages, traveling expenses of superintendents, also the salaries and expenses of patrolmen over the entire extent of the lines, a patrolman being stationed about every 30 miles, and as all circuits over 500 miles long require automatic repeaters, repeater stations and skillful attendants are necessary in many places, at a large expense, which is all chargeable *pro rata* to every telegram.

Such being true it is obvious that the cost of the sending and receiving operator for any one particular telegram is but a small part of the total cost of handling the average telegram, which, in addition to the above expenses, must bear its share of the wages of operators idle as well as busy.

An Inventor's Reward.

According to English court records, which are reliable, Dr. John Hopkinson was paid very nearly $100,000 for his patent for the three-wire system of distribution.

The Interests of the Public in the Telephone Situation.—I.

BY F. W. DUNBAR.

TWENTY years ago the world was startled by the announcement that speech had been successfully transmitted to a distance by means of the electric current. To-day in the United States alone two and one half million conversations are daily carried on by means of the telephone. The commercial world has long since ceased to regard the telephone merely as a novel and useful adjunct, but recognizes it as a necessary factor in the speedy and successful transmission of its business. From the moment that Philip Reis successfully transmitted musical sounds and fragmentary words by means of the electric current, it was recognized by certain scientific men that one element only was lacking in order to successfully transmit speech. Alexander Graham Bell supplied this element. Reis had been varying the rapidity of vibration only of the current transmitted. It was necessary to vary also the form of the vibrating current, so that the variations of the current would always correspond to the variations in the form of the sound-waves produced by the voice. This was the invention of Bell. The Patent Office recognized his invention, the Bell Telephone Company recognized its value, and, successfully defending his patent against all alleged prior inventors, have justly reaped the benefits of the protection granted to an inventor by the United States through its Patent Office. The Bell Company's monopoly has been completely and financially successful. The public has paid voluntarily, if not cheerfully, the price required for building up a telephone system second to none in the world in magnitude and value. The public now, after 20 years of this monopoly, demand that the beneficial results of competition, with the inevitable reduction in rates, improvements in service and increase in facility and extent of use, shall be allowed them. The fundamental patent on the method of telephony expired more than three years ago, after its full run of 17 years. The magneto-telephone has been free to the public for more than two years. The Blake and numerous other transmitter patents have long since expired. Only one obstacle remains in the way, *i. e.*, the Berliner patent, which is construed by the American Bell Telephone Company to cover broadly all forms of commercial telephone transmitters which have been successfully used since 1878.

The details of the suit of the United States against the American Bell Telephone Company for the cancellation of this patent on various grounds, besides the long delay of 14 years in the Patent Office, are too well known to require elaboration. The importance of the decision of the Supreme Court, however, and its bearings on the interests of the public, can not be overlooked.

The unsuccessful attempt of the American Bell Telephone Company to prolong their exclusive monopoly of the telephone business by changing the interpretation of Section 4887 of the Revised Statutes will be remembered in the late Bate refrigerator case. By this decision of the Supreme Court, upholding the reading of this section, the fundamental carbon telephone patents of Edison, which were the companions of the Berliner patent in its long sleep in the Patent Office, and which were finally issued subsequent to their expiration by foreign limitation, were made null and void. The recent expiration of the 17 years' contract between the Western Union Telegraph Company and the American Bell Telephone Company, by which these two great companies agreed to abstain from mutual competition, and the practically simultaneous expiration of the fundamental Van Rysselberghe patents covering the successful combination of the telegraph with the telephone, together with the expiration of numerous broad patents on telephone switchboards and switching devices, all point to developments in the near future concerning which the decision of the Berliner case has a most intimate bearing, and concerning which the public has a profound interest.

In this connection it may not be inappropriate to discuss the inherent difference between the magneto-transmitter which is free for the public to use, and the battery transmitter or microphone which the Berliner patent purports to broadly claim.

Ohm's law $C = E \div R$, shows us that the current in an electric circuit may be varied in two distinctly different ways, *i. e.*, either by varying the active component E, or by varying the passive component R. By either method the resulting current undulation will be similar in form to the variation impressed upon the component E or R. Suppose, first, we vary the active component, *i. e.*, the E. M. F., by allowing the sound-waves to act upon and force into vibration the armature of a magnet. The magnet may be either permanent or separately excited. Fig. 1 represents such a telephone. It is a magneto-telephone. Induced currents are generated in the coils wound on the magnet of the transmitter, and three current undulations are similar in form to the sound-waves acting upon its armature. The current is received by a similar magnet at the receiving end of the line and forces the armature of this magnet into vibrations similar to the vibrations forced upon the transmitting armature. But the energy is derived from the voice. Each transformation of the energy from mechanical to electrical, and back to mechanical, energy is accomplished at a certain loss. The received sound is necessarily much weaker than the sound affecting the transmitter

FIG. 1.

armature. No improvements in magneto-telephones can greatly increase their limited power, no more than any improvements in an electrical generator can increase its output beyond the power delivered to it by its driving motor. The quality of the transmission from magneto-telephones is excellent, but their power of transmission is limited, too limited for commercial work.

On the other hand suppose the passive element R be varied. The energy of the voice is now used only to operate the throttle valve, as it were, of the energy which may be furnished by a powerful battery or other seat of E. M. F. No longer is the power of the telephone limited to the energy of the sound-waves effecting the transmitter. It is limited only by the power of the battery and by practical requirements. The voice of a speaker may be magnified, has been magnified, to many times its original energy and transmitted many hundreds of miles to fill an audience hall more completely than though the speaker were present. Fig. 2 shows such a transmitter. It is a microphone. The variation in the electrical energy is secured by regulating the flow of energy from the battery by means of the variable resistance transmitter T. The resistance

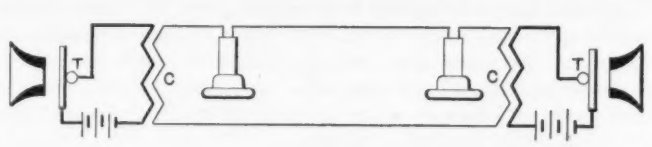


FIG. 2.

in this transmitter is caused to vary by the action of the sound-waves on the diaphragm, and caused to vary in a manner so as to produce electrical undulations similar in form to the sound-waves.

Numerous methods of obtaining this variation in resistance have been devised, but all depend upon the one well-known principle of securing a change in resistance by varying either the length or cross-section, or both, of the poorly conducting medium. Only in this manner can a variation in resistance similar in power to the sound-waves be secured. The changes in resistance due to variations in temperature are too slow in comparison with the high rate of vibration of the sound-waves to be adopted for telephone purposes. The changes in resistance due to variations in the illumination of certain crystalline substances, such as selenium, have not been found practical for commercial purposes.

All battery transmitters or microphones which have been or are in commercial use depend for their variation in resistance upon a change in the number of conducting molecules which take part in the transference of the current through the variable resistance medium. And in all such transmitters this change in resistance is accomplished by the action of the sound-waves acting upon a suitable diaphragm and communicating its motion to the point of variable resistance.

The United States Patent Office granted a patent to Alexander G. Bell in 1876, covering broadly the method of using electrical undulations similar in form to sound-waves for telephonic purposes. Bell also patented, in the same grant, the method and apparatus of the magneto-telephone and the method of the microphone. He did not patent the apparatus of the microphone. It appears that at that time Bell did not realize that it was the microphone and not the magneto which was destined to fill the requirements of the commercial transmission of speech. However, Bell built and successfully operated before the public a microphone transmitter in 1876.

This was his liquid transmitter, and he secured his variations in resistance, causing electrical undulations similar in form to the sound-waves by means of a variable, though continual, contact between a metallic or carbon rod and a liquid surface. Nearly a year later Berliner devised his transmitter, which differed only from Bell's in the substitution of a metallic surface for the liquid surface, thus returning to the exact mechanical structure of the old Reis telephone. It appears that Berliner had no better success than Reis with this form of instrument up to June 4, 1877, for he states in his application of this date that "these simple instruments will reproduce any musical sound uttered in the neighborhood of one of them, but for the reproduction of special sounds as speech they are not adapted." Berliner used at this time special "make and break" transmitters for the reproduction of speech. Meanwhile Edison had discovered the highly superior qualities of carbon for microphonic purposes, and made application for his carbon transmitter. But the Berliner patent, as issued 14 years later, described and broadly claimed the method of producing electrical undulations similar in form to sound-waves by means of a constant-contact variable-pressure transmitter. The strength of the position taken by the American Bell Telephone Company lies in the breadth of this claim. However certain those who represent the interests of the public may be that these claims of Berliner, as interpreted by the American Bell Telephone Company, to cover all forms of microphones, could not be maintained by them in a suit brought by the American Bell Telephone Company against an alleged infringer, yet should the Supreme Court decide that the patent itself is a valid one and thus place the public again upon the defensive, years would probably elapse before the final settlement of the case, and during this period the mere possession of the patent by the Bell Company would tend to deter the free investment of capital in telephone enterprises, by which means alone can the public hope to secure the many advantages of a healthy competition in one of the most fruitful fields of electric industry.

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

For 20 years the public has witnessed the independent growth of the telegraph and telephone industries. This unnatural separation of two great interests which are naturally so closely allied has been due to the existence of a contract between the Western Union Telegraph Company, including its allied interests, and the American Bell Telephone Company, by which contract the Western Union Telegraph Company agreed to confine itself for a period of 17 years to the transmission of messages by telegraph, and the American Bell Telephone Company agreed to confine itself to the direct transmission of messages between two parties by means of the telephone for a similar period of time. Thus the Western Union Telegraph Company agreed that:

"The right to all uses of the telephone on wires of a district or exchange system is to remain exclusively" with the American Bell Telephone Company, while the American Bell Telephone Company agreed that its lines "are not to be used for the transmission of general business messages, market quotations, or news for sale or publication in competition with the business of the Western Union Telegraph Company or with that of the Gold and Stock Telegraph Company."

This famous contract expired on Nov. 1, 1896. No longer, it appears, is the American Bell Telephone Company under obligations to refrain from competing with the Western Union Telegraph Company for the telegraph business of this country, and no longer is it required to limit its Morse business to private line service under the "general business message" stipulation.

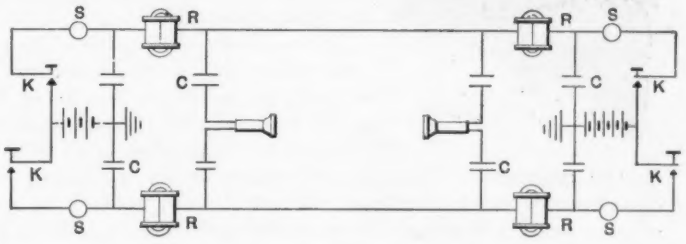
On the other hand the Berliner patent alone apparently forms the only obstacle to active competition in a field already shown to be of great value and capable of immense possibilities from an economical standpoint, *i. e.*, the simultaneous transmission of telephone and telegraph messages on the same wire.

The patents to François van Rysselberghe covering fundamentally that system of combined telegraphy and telephony which years of actual service have shown to be best adapted for commercial work, expired in the Spring of the year 1896 by foreign limitation. The principle of the operation of this system is illustrated in Fig. 3. Each complete metallic telephone circuit forms also two independent grounded telegraph circuits. The essential requirements of such a system are that the two telegraph circuits shall be perfectly independent one of the other, that the telephone circuit shall be entirely free from any disturbances caused by the telegraph currents, and finally that the Morse instruments shall be unaffected by any telephone or telephone signaling currents sent over the circuit.

The first requirement is met by completing the telephone circuit at each end of the circuit through condensers, two at each end of the line, of sufficient capacity to allow the passage of the telephone currents without loss. The introduction of these condensers prevents cross-writing from one telegraph circuit to the other.

The second requirement necessitates the use of retardation coils (R, R_1) placed in the telegraph circuits, one at each end of each circuit, but placed so as not to enter the telephone circuit. The object of these coils is as follows:

When the Morse key (K) is depressed and the circuit established from one station to the other, the sudden rush of the current onto the line which would occur in ordinary working is prevented by the retardation coils. Similarly, on breaking the circuit at the key, the



retardation coils, built with special reference to the securing of a closed magnetic field, and assisted by the condensers C, which are legged to ground from each side of the circuit, prevent a sudden discharge of the line. The result is that the Morse signals, while not delayed materially in speed, are established and terminated with a gradual curve instead of with the usual abruptness. The telephone responds only to the changes in current. The rate of change of the comparatively slow Morse signals, when thus rounded, is too slight to affect the telephones which are placed in the branch circuits between the two main lines.

The third requirement, that the telegraph instruments shall not be affected by the telephone currents, is met by the high impedance which the retardation coils offer to the telephone currents, and by the path of low resistance offered to the telephone currents through the branch circuit including the condensers.

The telephone circuit operates as noiselessly and efficiently as though separated by miles from any disturbing source. The two independent Morse circuits operate as clearly and uniformly as though their line wires were not shared with the telephone circuit. The earning capacity of the two wires, however, has been doubled at the slight cost of equipping its terminals with coils and condensers.

The diagram represents the line equipment for simple Morse circuits; it will be understood, however, that the system is applicable to the duplex and quadruplex as well.

The problems of line transpositions on long-distance circuits are not modified by this combination of the telegraph with the telephone. The mutual interference between adjacent circuits is avoided in the same manner and degree as before by systematically crossing the two conductors of each circuit at certain definite points.

The economic possibilities in the transmission of news by means of this combined use of the telephone and telegraph can be readily appreciated, especially as the system is just as applicable to local or city service as it is to long-distance or inter-city service.

(To be continued.)

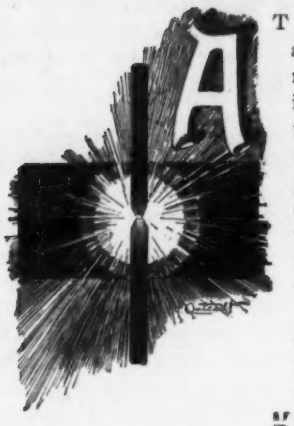
International Electrical Exhibition in Turin.

We learn through *Nature* that it is proposed to hold an international electrical exhibition at Turin, Italy, in 1898, and that the Executive Committee and Exhibit Commission invite exhibits from all parts of the world. The exhibition will comprise the following classes: Apparatus for teaching electrotechnics; materials for the conduction of electricity; instruments for electric and magnetic measurements; telegraphs and telephones; signaling apparatus for safety appliances on railway; lighting and heating of cars; dynamos and motors; mechanical appliances in electric traction; electric lighting; electro-chemistry and electro-metallurgy; miscellaneous; apparatus of historic interest. Prof. Galileo Ferraris has been appointed president of the commission.

Alternating Current Machinery.—I.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

Introductory.



At the present time alternating currents are extensively employed in the transmission of power; as very feeble currents in telephony, and as strong currents for transmitting large amounts of power to comparatively great distances. It is purposed in this series of articles to discuss the development, laws and properties of alternating currents and the methods of their practical application to the transmission of power.

The discovery by Faraday of the principle of dynamo-electric induction, announced to the Royal Society of London in 1831, formed the basis for the construction and operation of all dynamo electric generators. The form of generator which Faraday then described produced continuous currents directly without the use of a commutator. Nearly all the early forms of generators which were produced shortly after the announcement of the discovery of Faraday, as for example those of Dal Negro, Pixii, Ritchie, Clarke and Saxton, produced alternating currents, which however, were commuted into unidirectional currents.

Perhaps the first alternating-current generator whose current had an industrial application was the Alliance machine, the result of the joint labors of Nollet, Holmes and Van Malderon. This machine was employed in the lighthouse of La Hève in 1863 for the supply of alternating currents to an arc light of 1900 nominal candle power.

The Alliance generator is represented in Fig. 1. It consists of a frame carrying eight sets each of five fixed compound permanent horse-shoe magnets, having their opposite poles successively facing each other. Between these magnet poles are revolved a number of armature spools or bobbins arranged on the circumference of a cylinder. There were twice as many bobbins as magnets; consequently there were produced 16 reversals of current per revolution. The number of revolutions being 400 per minute, the number of reversals per minute would be about 6400, representing a frequency of about 106 reversals per second. These machines are still in use in lighthouse service.

Although alternating currents were, in the case of the Alliance machine, thus practically employed in lighthouse illumination, yet, for a considerable period, nearly all subsequent machines were provided with commutators, unidirectional currents being generally preferred to alternating currents. Probably the principal reason for this preference was that most of the practical applications of electricity employed the voltaic battery as source, and the dynamo-electric generator was thus made to produce a current of the same type.

The invention by Jablochkoff of his electric candle in 1876, however, wrought a change. Jablochkoff found that it was impossible to operate his lights satisfactorily by means of continuous currents, owing to the fact that the positive carbon, consuming about twice as fast as the negative, caused the distance between two fixed parallel carbons soon to become too great for the arc to be maintained. His solution of this difficulty by the use of alternating currents resulted in a stimulus to the production of alternating-current generators. In 1877 Gramme produced a type of alternating-current generator, which is illustrated in Fig. 2, designed for use with the Jablochkoff candle. Here eight electromagnets, arranged radially around an axis and provided with curved pole-pieces, are revolved within a fixed cylindrical frame wound with insulated wire and connected with the external circuit or circuits.

In 1878 Von Hefner Alteneck produced a form of alternating-current machine, generally known as the Siemens machine, and represented in Fig. 4. In this machine a disc armature has mounted upon its surface a number of bobbins, which are revolved between the poles of electromagnets. Sixteen of these spools are mounted in the machine represented in the figure, so as to rotate between 16 pairs of opposed electromagnetic pole faces.

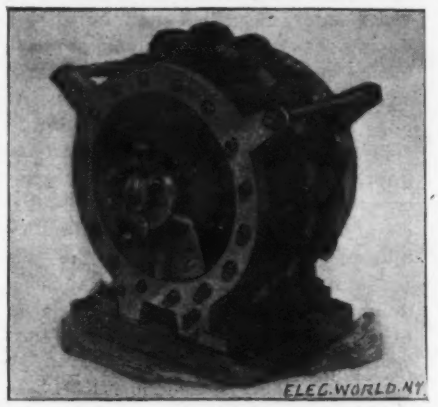


Fig. 4.—Siemens' Alternating-Current Machine

In 1879 De Meritens produced a magneto alternating-current generator somewhat resembling the Alliance machine. In one form of this machine, represented in Fig. 3, an iron ring, containing segments wound with wire, was made to revolve within a set of pole-pieces attached to per manent compound magnets. In the machine represented, 16 such segments revolve within 16 polar projections.

Jablochkoff's candle failed to maintain its commercial supremacy in competition with improved forms ot arc lamps employing continuous currents. The disuse of the Jablockoff candle temporarily restrained the further development of alternating-current generators, but some of the advantages of the alternating current had even then been observed, and, although continuous-current generators rapidly extended their application, yet the alternating-current generator still found a field of employment in incandescent lighting. The introduction of the alternating-current transformer, about the year 1882, opened up a new field to the use of alternating currents. From this time the flexibility of the alternating-current system, whereby the pressure of transmission could be readily raised or reduced by transformers, without the use of any revolving mechanism, gave to alternating currents an advantage over continuous currents for long-distance transmission which has ever since been retained.

The use of alternating currents which followed the introduction of the transformer was for some time limited to incandescent and arc lighting, by the fact that no motors of any considerable size could be operated by alternating currents. In 1884 Dr. Hopkinson announced the discovery that two alternators brought into syn-

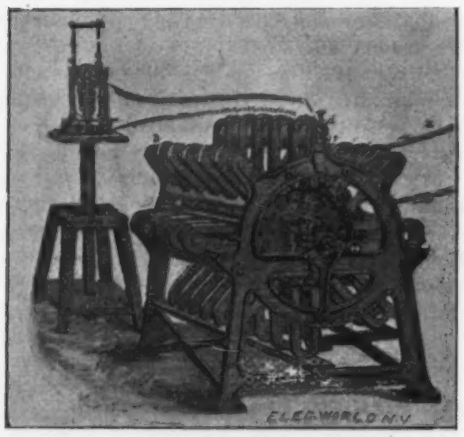


Fig. 1.—The Alliance Magneto-Electric Machine.

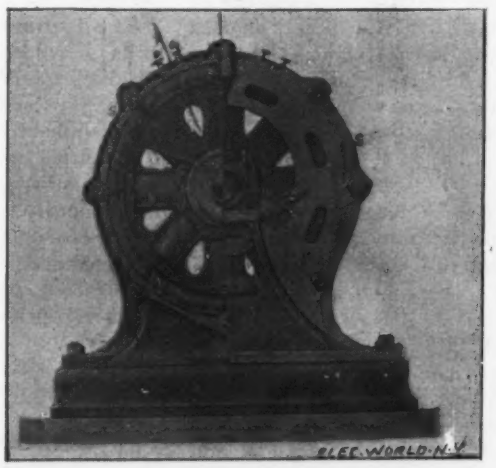


Fig. 2.—Gramme's Alternating-Current Generator.

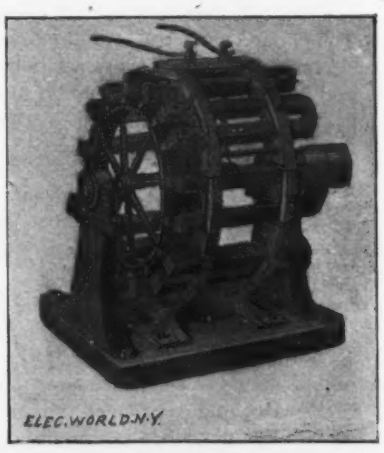


Fig. 3.—De Meritens' Alternating-Current Machine.

chronism by independent mechanical means could be operated together on the same circuit, one as a generator and the other as a motor. The fact, in its simplest form, had already been observed by Wilde in 1868 and by Deprez at a later date, but the significance of their observations had been lost sight of. As a result of Hopkinson's discovery it was found possible to operate an alternating-current motor as a synchronous motor, provided it was first started, brought up to the proper speed and connected to the alternating-current mains at the proper instant of time. In practice this necessity was found to be a great objection, and only large motors that were to be continuously operated for many hours together could be conveniently operated in this way.

It was not until the invention of the multiphase system of alternating-current transmission, about the year 1888, that alternating current motors of any considerable size could be started from rest when connected to alternating-current mains. The multiphase system, consequently, gave a great stimulus to alternating-current distribution.

In 1891, during the Frankfort exhibition, about 200 horse-power was successfully transmitted by three-phase alternating currents, from Lauffen to Frankfort, a distance of 109 miles; the net efficiency being about 75 per cent., at about 15,000 volts pressure. This feat, while not representing a commercial transmission of power, nevertheless gave a great incentive to enterprise in this direction.

Multiphase transmission has come into extensive use in America since 1892, and is employed in the distribution of power to distances up to 30 miles, employing pressures as high as 11,000 volts.

In 1895 the multiphase alternating-current distribution system of Niagara Falls was set in operation. This system is the most extensive in use up to the present time, and employs the largest generators now in use, each being of 5000 horse-power. This power is at present being transmitted to Buffalo, a distance of 21 miles, at a pressure of 11,000 volts.

(*To be continued.*)

Principles of Electrical Distribution.—III.

BY FRANCIS B. CROCKER.

Current-Carrying Capacity of Conductors.

The third objectionable effect of resistance in electrical distribution is the heating which it causes. The production of heat in an electrical conductor has already been stated to in terms of the various quantities involved. This heat is an absolutely definite and unavoidable result of the flow of the current. Its effect is to raise the temperature of the conductor, and this rise continues until the heat lost is equal to the heat generated; then the temperature becomes constant. It is obvious therefore that any electrical conductor is only capable of carrying a certain current with a given elevation of temperature, and in practical work the allowable temperature is limited by considerations of injury to insulation, danger of fire, etc. No exact general rule for current capacity can be given, as much depends upon the particular conditions in each case. But since a wide margin must be allowed between the danger point and the permissible current capacity, it is possible to establish rules which are somewhat

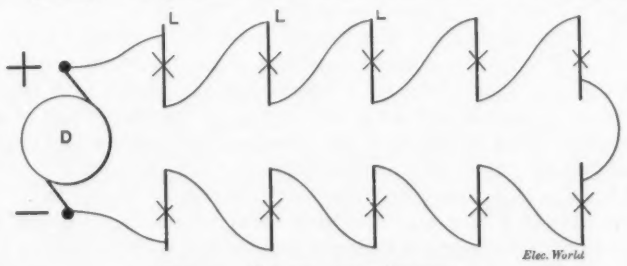


FIG. 1.—SERIES ARC CIRCUIT.

arbitrary, but sufficiently safe in almost any case. This is practicably the basis upon which tables are made giving the current that it is allowable for any size of wire to carry. These tables are largely the results of experience, but can be arrived at more or less accurately by calculation.

The first rule of this kind was given by Lord Kelvin. It stated that the current density in copper conductors should not exceed 1000 amperes per square inch of cross-section. This is sometimes modified so that 1000 amperes is allowed in a round conductor one inch in diameter. Since such a conductor has a cross-section of 1,000,000 circular mils, this amounts to saying that the maximum current density may be one ampere per 1000 circular mils. This rule has sometimes been stretched to permit 2000 amperes per square inch. But no rule of this kind can properly be applied to different sizes of conductors, for the reason that small wires can carry relatively greater currents than large wires, the surface compared with the cross-section being more in the case of the former.

Prof. George Forbes has discussed this problem in a paper read before the London Institution of Electrical Engineers in March, 1884.

Mr. A. E. Kennelly has given the results of his investigations in papers before the conventions of the Association of Edison Illuminating Companies, Aug. 13, 1889, and Aug. 11, 1893. This work is generally accepted as correct and authoritative.

The following are standard tables of maximum current-carrying capacity of different sizes of wire.

A. W. G.	Table 1.	Table 2.	Table 3.
0000	175	218	312
000	145	181	262
00	120	150	220
0	100	125	185
1	85	105	156
2	70	88	131
3	60	75	110
4	50	63	92
5	45	53	77
6	35	45	65
8	25	33	46
10	20	25	32
12	15	17	23
14	10	12	16
16	5	6	8
18	3	3	5

Table No. 1 is based upon Kennelly's experiments, and is intended to allow a rise in temperature of 75 degrees Fahr. for twice the current specified, thus allowing an ample factor of safety. The normal current would only raise the temperature about 19 degrees Fahr., the heating effect being proportional to the square of the current. The rules of the National Board of Fire Underwriters which permit a current density about 25 per cent. greater than the foregoing, the figures are given in Table 2. This would give a temperature elevation of about 30 degrees Fahr., and would still allow a considerable increase (about 60 per cent.) in current above the normal without injurious effects. This table covers "concealed work," and Table 3, which permits a still greater current density, is used for "open work."

Series Systems.—The simplest arrangement of lamps or other devices to be supplied with electrical energy is a series system, in which the current from the dynamo *D* passes first through one lamp *L* and then through another, and so on, as shown in Fig. 1. In such cases the current is usually maintained at a constant value, hence the expression *constant current* is practically synonymous with *series* in electrical distribution. It is also a fact that the voltage usually employed in these systems is high, being equal to the pressure consumed in each lamp multiplied by the number of lamps. For example, sixty lamps are commonly placed upon a single arc-lighting circuit, and since each lamp requires 50 volts it follows that the total pressure is 3000 volts. The problem of designing or studying series circuits is not difficult, since the path of the current is usually simple, and the current is constant and uniform throughout the circuit. This last statement is only true, however, if the leakage of current is insignificant, which is generally the case in electric light and power distribution. In high-potential systems this condition is practically necessary, since any considerable leakage of current would be dangerous not only to persons, but to property as well.

Distribution of Potential on Series Systems.—The potential on a series system falls throughout the circuit in direct proportion to the resistance. That is $e = ir$, the difference of potential e in volts between any two points being equal to the product of the current i in amperes, and the resistance r in ohms. This simple fact completely covers any possible problem that can arise in connection with a series system, provided a direct current is used, and is easily applied in almost any case. But it may be interesting to consider in this connection certain points which are not generally understood. In Fig. 2 an arc-lighting system is represented, *D* being the dynamo and *L*, *L*, *L* the lamps, connected in series in a circuit. The total difference of potential generated by the dynamo is 1000 volts, measured between the two brushes marked + and —. This potential falls as the current traverses the circuit, 50 volts being consumed per lamp. This is made up of 45 volts actually used in the lamp itself, and a drop of five volts on the conductor between two lamps. That is, the drop on the line wire is 10 per cent. of the total E. M. F. The relative potential of the various points on the circuit is easily found. For example, between the + brush and the middle point *M* of the circuit, there is a difference of potential of 500 volts, and the same amount between the middle point and the — brush. Similarly any two points on the circuit will have a difference of potential equal to

50 volts multiplied by the number of lamps included between these points. But when it is attempted to determine the *absolute* potential, the problem is not so simple. It is customary to consider that the middle point *M* of the circuit has zero potential, *i. e.*, equal to the potential of the earth, and that the positive brush is + 500 and the negative brush — 500. While this is a possible, and perhaps a general condition, it is by no means universally the case. In fact there is no necessary relation between the potential of any point on the circuit and that of the earth. It depends simply upon the conditions in each case. If the insulation of the circuit were absolutely perfect its potential with respect to that of the earth would depend simply upon the initial electrostatic charge which it might happen to have. If, for example, it were originally charged to a positive potential of 1000 volts, the — brush, while the dynamo was operating, would be + 500 volts compared with the earth, and the + brush would be 1500 volts above the potential of the earth. The difference of potential would still remain 1000 volts between the + and — brushes and the *distribution* of potential would also be unaffected, but the *absolute* potential would depend upon the initial charge. If the latter happened to be 1000 volts negative, the positive brush would be—500 and the negative brush—1500 volts. If the initial charge is zero, then and only then would the middle point of the circuit have an absolute potential of zero.

In practice it is of course impossible to obtain perfect insulation and any initial charge given to the circuit would gradually leak off to the earth, so that the potential of the middle point of the system would tend to become equal to that of the earth; but this is only true if the insulation is uniform throughout the circuit, which is not likely to be the case. If there happens to be a defect in the insulation at some point, even if very slight, then that particular point will tend to approach the potential of the earth. For example, assume the negative brush to be grounded. In that case its potential would become zero, the middle point of the circuit would be +500, and the positive brush would be +1000 volts. Even when there is not an actual ground connection or defect, the insulation is likely to be somewhat poorer on one side of the circuit than on the other. In this case the point of zero potential will be shifted toward that side of the circuit.

Let us now apply these possibilities to the important questions of personal danger in connection with series circuits.

Personal Danger from Series Circuits.—If a man standing on the ground touches a very highly insulated circuit, only a very slight current will pass through his body, but if the insulation is low or any defect exists at any particular point, then a considerable current may flow through his body. In Fig. 2 the circuit is supposed to have a ground connection at the point *P*. This will cause the potential to be zero at that point; consequently a man may stand on the ground and touch the circuit at that point with perfect impun-

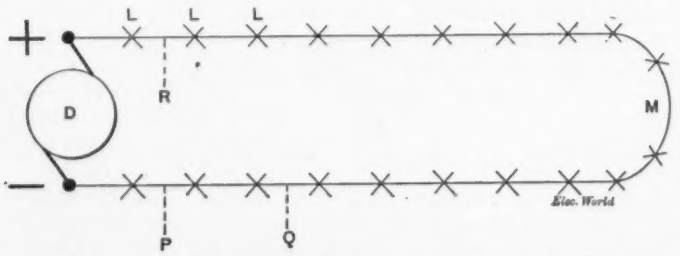


Fig. 2.—Distribution of Potential on Series System.

ity. If, however, he touches the wire at the point *Q*, he will receive a barely perceptible shock due to 100 volts, since there are two lamps between that point and the ground connection; but if the circuit is touched at that point *R*, the difference of potential between it and the ground connection being 900 volts will produce a dangerous or perhaps fatal current. When the defect in the insulation does not amount to what is called a "dead ground," but has a certain resistance, for example, 1000 ohms, then a man touching the wire at the point *R* will received a shock due to 900 volts, but the resistance of the ground connection, which is 1000 ohms, will be in series with his body, and consequently the current will be less, and assuming the resistance of his body to be 1000 ohms, the current will have one half as much as in the first case. If the ground connection has a resistance of 8000 ohms, the current through the body would be $\frac{900}{8000 + 1000} = \frac{1}{10}$ of an ampere, which is not dangerous. We may sum up these various cases as follows:

(1) A very highly insulated direct-current electrical circuit may be touched at any one point without danger, by a man standing on or in connection with the ground.

(2) If a ground connection exists on an electrical circuit the danger of touching the circuit increases directly with the resistance between the ground connection and the point of contact.

(3) The resistance of the ground connection is in series with the body of any one connected with the ground, and touching the wire.

(4) It is never safe, however, to assume the insulation to be perfect or that a ground connection exists at some particular point, or that it has a high resistance. The circuit should always be treated as if the most dangerous possible conditions existed.

Regulation of Series Systems.—The condition required on series circuits is usually the maintenance of a *constant current.* In practice this is accomplished by designing the dynamo so that it will automatically generate a nearly constant current. The various dynamos used in series arc lighting, such as the Brush, Thomson-Houston and Wood machines, are well known examples of this type of generator. These and other forms are provided with regulating devices, which either shift the brushes or vary the strength of the field, or both, in order to keep the current at a constant value. In addition to these special regulators these machines are so constructed that the armature-reaction tends to prevent the current from rising to a high value, even when the machine is short-circuited. Furthermore, arc dynamos being usually designed to generate a high potential, contain a great many turns of wire both on the armature and on the field, and consequently their self-induction is great, and opposes any sudden increase or decrease in current strength. The principle and construction of these machines and the various forms of regulators with which they are provided are fully described in works on the dynamo.[1] Considerable variations in current occur on most of the so-called constant currents, particularly with those used for arc lighting. This is due partly to unsteadiness in the feeding and burning of the lamps, and partly to the fact that the regulators have not been made very sensitive, because a slight variation in current is not noticeable or objectionable in arc lighting, but might be very perceptible in the case of incandescent lamps. For example, a fluctuation from nine to eleven amperes would not produce a very great effect upon an arc lamp, but would cause extremely disagreeable flickering in incandescent lamps.

The most important systems of series lighting are as follows:

(1) The ordinary series arc-lighting system.
(2) The same with series incandescent lamps.
(3) The so-called "municipal" systems of incandescent lighting.
(4) The series-parallel systems.
(5) Alternating-current series systems without transformers.
(6) Alternating-current series systems with transformers.

Series Arc-Lighting Systems.—Direct-current.—This was the first successful method of distribution introduced for electric lighting. The original Brush arc-lighting system is a practical example. The apparatus and arrangement required are all quite simple, consisting of an arc dynamo, usually provided with a regulator to maintain a constant current, and lamps connected in series by a single line wire, as represented in Fig. 1. The action of such a circuit and the distribution of potential upon it has already been discussed. The two important questions which arise in connection with the installation of such a system are the choice of a type of dynamo and lamps, and the determination of the proper size of wire to employ. The selection of the dynamos and lamps would depend upon various commercial considerations, there being a number of well-known and thoroughly successful forms of apparatus. The determination of the size of wire is not very difficult. General custom and considerations of strength require that no wire smaller than No. 8, A. W. G., should be used. Similarly it would not usually be necessary to employ a conductor larger than No. 4, because the potential being high, and the current small, the loss of energy is not great in a wire of several miles in length. To take a specific case, let us assume a circuit five miles long, supplying 80 arc lamps, the potential being 4000 volts and the current 10 amperes. If No. 6 wire is used, the resistance would be 2.1 ohms per mile or 10.5 ohms for the whole line. This involves a drop of 105 volts and a loss of energy of 1050 watts, which is only 2.63 per cent. Even if the circuit were 10 miles long, the loss of potential or energy would only be 5.25 per cent.; consequently it is evident that the use of a little larger or a little smaller wire would not seriously affect the economical working of such a line, and the cost of copper is also very small

[1] Crocker. *Electric Lighting*, vol. i., p. 330.

compared to the energy transmitted. But if, in any given case, it is desired to determine exactly what size of wire it is best to adopt, we can then calculate for each of several sizes the cost of the wire, and the laying of it, and also the loss of energy in each case, and then decide whether it would be worth while to increase or decrease the weight of copper in order to secure the highest economy, everything considered. In the case already assumed, the substitution of No. 3 for No. 6 wire would have saved exactly one half the loss of energy and the cost of the copper would have been approximately doubled. The energy saved, 525 watts, would have a certain value per annum, depending upon the cost of coal and other local circumstances. The larger size of conductor would involve a certain additional first cost. In many cases the larger size of wire would secure a saving of energy greater than the charge on the increased investment; but it should be remembered that the cost of laying and repairing the larger wire would be considerably greater, and its unsightliness would be quite a drawback in the case of overhead conductors. It is therefore very doubtful whether it would pay to put in the larger wire simply to save a small amount of energy, only amounting to about 1.31 per cent. of the total power generated.

(*To be continued.*)

Motors as Distinguished from Dynamos.

To the Editor of The Electrical World:

SIR:—Allow me to call your attention to the editorial in the issue of Dec. 12 on "Motors as Distinguished from Dynamos." In it, if I am not very much mistaken, you are somewhat at fault. You write: "Whereas in a dynamo, armature reaction has a tendency to weaken the field, very objectionable with heavy loads, the same effect in a motor increases the field strength, thereby producing a positive advantage, inasmuch as it tends to maintain the speed constant with increasing loads." This statement would be true, provided that the brushes maintain a forward lead in the motor, as is the case with the dynamo. But as the condition of sparkless running for a motor necessitates the brushes being rocked backward, there is no change in the direction of current through the portion of armature within the double angle of lead, and consequently no difference between the armature reaction of a dynamo or of a motor.

As the increase of speed in a shunt-wound motor is produced by the decrease of its field strength, which action was pointed out in the portion of your editorial devoted to the effect of the insertion of a resistance in the field circuit, it follows that the demagnetization caused by the back ampere-turns enables the motor to maintain its speed with increasing loads, while an increase of field strength, as suggested by your article, would produce an opposite effect and cause the motor to slow down.

M. B. CRIST.

THORNTOWN, IND.

To the Editor of The Electrical World:

SIR:—In your issue of Dec. 5, page 693, Mr. Wiener makes the following statement: "In the generator the proper position of the brushes is determined by the sum of the influence of armature reaction and of self-induction, while in a motor it depends upon their difference; in a motor therefore the shifting of the brushes is less than that in a generator by double the effect of the self-induction; as the weakening of the field by the armature increases proportional to the lead (or lag), it follows that in a generator the armature current weakens the field more than in a motor." Every student of the subject is supposed to know that the extra shifting of the brushes of the motor, necessitated by the self-induction of the armature coils, is backward, and not the reverse, as Mr. Wiener's statement would lead us to suppose.

Suppose that the brushes of a motor have been shifted backward until the coils under the brushes have been brought into the neutral field; *i. e.*, where they are developing no E. M. F. As each coil approaches a brush, the E. M. F. developed in it is opposed to the current. The E. M. F. of self-induction tends to cause a rush of current at the instant when the coil is short-circuited by the brush unless the coil be developing an opposing E. M. F. In order to obtain this opposing E. M. F. it is evident that the brushes must be shifted still farther backward as a forward shifting would bring the coil at the instant of commutation into a field where the induced E. M. F. is in the same direction as that of the current which you wish to check.

In the next sentence Mr. Wiener says: "The magnetic field due to the eddy currents is less in the generator than in the motor. on account of the diminished waste field"

I cannot see why there should be any appreciable difference between the waste field of a generator and that of a motor of like capacity and similar design, or that such a difference would have any effect upon the eddy currents in the armature core, which currents, with a given core, depend upon the total magnetic flux through the core, and its speed of rotation.

In your editorial comment on Mr. Weiner's article, I find the following, "Whereas in a dynamo armature reaction has a tendency to weaken the field, very objectionable in heavy loads, the same effect in a motor increases the field strength, thereby producing a positive advantage, inasmuch as it tends to maintain the speed constant with increasing load."

I think that you will find, by a more careful perusal of Mr. Wiener's article, that he did not draw any such conclusion. In the first place, the armature reaction in a motor tends to weaken the field, and therefore to keep the speed from dropping. In the second place, if it did strengthen the field, the result would be a drop in the speed, instead of a tendency to maintain a constant speed.

CAMBRIDGE, MASS. C. A. ADAMS.

[Both Mr. Crist and Mr. Adams are correct in their statements. By an oversight, the clause in the editorial above referred to is incorrectly stated. It should read—the same effect in a motor produces a positive advantage, etc.—ED.]

On the Measurement of the Insulation Resistance of Street Railway Cables.

To the Editor of The Electrical World:

SIR:—I shall be greatly obliged to you for the insertion of the following remarks "On the Measurement of the Insulation Resistance of Street Railway Cables:"

The method described by Mr. Charles Hewitt on page 515 of Vol. XXVIII. is not so entirely new as that gentleman has imagined. I fully described the use of the bus-bar pressure and a voltmeter for the measurement of insulation resistance in 1888, in *Centralblatt für Elektrotechnik*, No. 22. At that time, of course, the Weston voltmeter had not appeared, and I used the torsion galvanometer of Siemens & Halske, but stated that in lieu thereof any other good pressure-meter could be used.

I have also published the method every year in my *Kalenders für Elektrotekniker*.

F. UPPENBORN.

MUNICH, GERMANY.

Penetrative Rays from Glow Worms.

Another addition to our knowledge of phenomena analogous in their properties to Röntgen rays is that contributed to *Wiedemann's Annalen*, No. 12, by Mr. H. Muraoka, of Kyoto, Japan, and abstracted in the London *Electrician*. The swarms of glow worms which adorn and illuminate the June nights in the neighborhood of Kyoto suggested that they might be made to show properties similar to those of Röntgen rays. Mr. Muraoka found, however, that they yielded something entirely new in the way of light. He placed 300 glow worms in a box with a sensitive plate covered with cardboard and metal and found that an impression was produced where the cardboard was placed on the sensitive plate but not where it was cut away. The cardboard seemed to exert an attractive effect upon the rays somewhat similar to the magnetic analogy of iron for lines of force. Probably the most striking property of these rays is that penetrative power is imparted to them by filtration through paper, cardboard or metal plates. Unfiltered glow worm light exerts no photographic effect whatever; it behaves like ordinary light and may be easily reflected, refracted or polarized. The glow worm rays, or more properly the Muraoka rays, show regular reflection and probably also refraction and polarization, but no action upon fluorescent screens or upon electric discharges. The active light comes from all parts of the body of the worm and penetrates its wings. It will be necessary to wait until next Summer for a repetition of these remarkable observations, when it is to be hoped that they will be verified and more thoroughly investigated.

Electrolysis Under Pressure.

In a recent after-dinner chat among electricians, the following question arose. If an infinitely strong vessel were completely filled with acidulated water, which is then electrolyzed between two electrodes in the vessel, what will be the result? We leave it to those interested to puzzle over it.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Armature Reaction in Unipolar Alternators. V. KANDO. *Elek. Zeit.*, Dec. 10.—A detailed discussion of the armature reaction in alternators in which the windings are all stationary and which he calls "unipolar," the first type of which was the well known Klimenko machine; during the last two years such unipolar machines have been introduced largely in Europe; constructively they have many advantages over machines with movable windings, and a superficial calculation would show very attractive results; but when the magnetic dispersion due to the armature current, and the influence of this dispersion on the loss of voltage, are examined as far as it is possible to do so by calculation, the advantages of such machines with reference to the loss of voltage becomes very doubtful; it is now possible to draw correct conclusions regarding them. He discusses this at some length, basing the calculations on results obtained in practice, and comes to the following general conclusions, the word "unipolar" being used in the above mentioned sense. It does not pay to construct such machines with a single armature if a small drop in voltage is desired; from the experimental data which he gives, he shows that with two armatures and otherwise like conditions, the machine gave 74 per cent. greater output than with one armature; the short circuiting current can be increased only to a small extent by increasing the air gap; there is a length of air gap for which this current is a maximum by increasing the peripheral speed, the short circuiting current becomes greater but the weight of the armature core and the copper on the magnet will then also increase appreciably; the iron parts of the field magnet then remain unchanged or increase much slower; by increasing the peripheral speed for the same output and voltage drop, the weight of the iron parts of the field magnets can be appreciably reduced; one should therefore choose the speed of machines having a low voltage less, so as to be as high as practicable; the relation between the short circuit ampere-turns and the magnet ampere-turns is for multipolar alternators 0.64 to 0.7, whereas in the cases under consideration it was 0.16 to 0.65, that is, the utilization of the magnet winding was rather unfavorable; the same was the case with the coefficient of magnetic dispersion. With reference to the utilization of the materials, it may therefore be claimed with certainty that the unipolar alternators are equal to the multipolar, having the same loss of voltage, only when the speed can be chosen so high, in proportion to the size of the machine, that the advantages in the construction of the rotating part can be fully utilized in well-proportioned machines.

Loss of Voltage in Alternators. BEHN-ESCHENBERG. *Elek. Zeit.*, Dec. 10.—A communication in reply to the recent communication by Rothert in that journal (see *Digest*, Dec. 19), who claimed that there were errors in the theory of the present author which gave rise to Rothert's theory; the present writer states that Rothert's theory agrees in all essential parts with the method which the present writer has used for three years, and which was published, among other journals, in THE ELECTRICAL WORLD; all the alternators constructed by the Oerlikon Company have been based on that theory, and he has not yet felt the need of any other method.

BEHREND.—The above is followed by a communication by Behrend replying to the same article of Rothert, to the effect that Rothert's method, as also those of Heyland and Arnold, leads to results which do not agree with his tests; the present writer points out the characteristic differences between the method of Behn-Eschenberg and those of the above-named writers, illustrating them with an example from which any one can see which of the theories leads to the best results.

BRAUN.—This is followed by a communication by Braun, in which he praises the article of Rothert, which he considers of great value, and discusses further the method of combining the ampere-windings.

Determining the Efficiency of a Dynamo. BARY. *L'Ind. Elec.*, Dec. 10.—A short article calling attention to the recently described method of ROUTIN (see *Digest*, Nov. 14 and 21), in which the efficiency was determined by the diminution in speed of a motor after the current was stopped; the present writer calls attention to a method which he described in *L'Elec.*, Oct. 19, 1889, and which he thinks in many cases would be simpler; the present description is not very clear; it appears that the method is for separating the mechanical resistances from the loss through the Foucault currents, hysteresis, etc., and it appears that heir sum must first be determined by the difference between the measured efficiency and the calculated electrical efficiency; the time T is noted, during which it takes the machine to come to rest after the current is broken, while the machine has its normal speed (presumably run as a motor); in the second test only the current passing through the armature is broken, and the time t is noted; letting P represent the sum of the losses above mentioned, then the mechanical losses will be equal to $\frac{P\,T}{t}$ and the electrical stray losses will be $P\left(1 - \frac{T}{t}\right)$; the quantity P may also be found by measuring the power necessary to revolve the armature in the normal field.

Designing a Bipolar Drum Dynamo. KENNEDY. Lond. *Elec. Rev.*, Dec. 11.—A conclusion of his serial (see *Digest*, Nov. 7) giving hints and directions of a very practical form. He discusses the proportioning of the field magnet, using the Manchester type of frame. Among some of the rules which he gives are the following: The flux density in the wrought iron portion of the magnet is about 12 lines per square inch and in cast iron 6 lines; 13.5 ampere-turns are required to magnetize one inch of length in wrought iron to a density of 12 lines per square inch, and 28.5 ampere-turns for cast iron for 6 lines per square inch.

Regulator for Series Motors. THURY system. *L'Eclairage Elec.*, Dec. 5.—An illustrated description of the apparatus. Such regulators must be extremely sensitive and prompt; the device consists of a sensitive tachometer operating a rheostat which shunts the field through the intermediary of a motor which drives the apparatus in one direction or the other, as determined by a lever operated by the tachometer.

Principles of Alternating-Current Working. HAY. Lond. *Elec. Eng.*, Dec. 11.—A continuation of his long serial which forms a sort of treatise on this subject, and has been running through the columns of that journal.

Hutin-Leblanc Alternator. Lond. *Elec.*, Dec. 11.—A reprint in abstract with the illustrations of the description noticed in the *Digest*, Dec. 12 and 5.

Care of Commutators. POOLE. *Amer. Elec.*, December.—The writer advises that No. 00 sandpaper tacked to a piece of board exactly the width of the commutator face, be used on the commutator for half a minute each time the machine is started, or once every 24 hours in the case of a continuously operated machine; the commutator should then be wiped thoroughly with a dry rag to remove the particles cut off by the sandpaper and which stick to the insulation between the segments; then the surface should be touched with a slightly oiled cloth, but otherwise clean, and then again wiped with a dry rag. The use of emery cloth is strongly condemned. The practice recommended is said to effectually remove the small brush cuttings which inevitably attend the use of copper brushes, and the burnt particles of carbon which result from the use of carbon brushes; the bits of copper, burnt carbon and insulation thus being removed before they can accumulate sufficiently to cause sparking and the cutting of both commutator and brushes.

Trueing a Commutator. LYNCH. *Amer. Elec.*, December.—Where for any reason the armature cannot be taken out to have a commutator trued, the writer advises that a piece of grindstone be used, first pressing it upon the commutator until a circular groove has been worn in the stone, and then moving it back and forth from end to end of the commutator until the surface is ground smooth.

Practical Method of Determining Faults on Armatures. Amer. Elec., December.—The method of Tinsley (see *Digest*, Nov. 14) is illustrated and explained and another method added which is said to accomplish the same results, but requires the use of only a telephone, the sources of current being a lighting circuit. As applied to a 100-light, 110-volt dynamo, 25 feet of No. 18 copper wire is looped between the brushes, a less length being used with larger armatures, its resistance being about twice that of the armature; the method of testing is to make contact with one telephone wire at the commutator segment adjacent to the brush segment, the other telephone wire being touched to the loop wire at successive points until a point is found at which the telephone gives no click; the first telephone connection is then moved to the next segment, the other remaining where it was and another point found at which there is no click, and so on; the various lengths thus found are equal in resistance to the armature loops to which they correspond.

LIGHTS AND LIGHTING.

Lighting of the Avenue de L'Opera. L'Ind. Elec., Dec. 10.—A brief description of the lighting of this prominent street in Paris, which has just been started. It is of interest because it is the first case in which alternating-current lighting is used on a large scale on a public street in Paris; the lamps are run five in series from the 220-volt mains and there

are 50 lamps in all; the lamps consume 36 volts and the self-induction coil for five lamps, 20 volts.

Luminous Fountain at the Budapest Exhibition. Zeit. f. Beleucht., Dec. 10.—An illustrated description; the general principle seem to be the same as that of other well-known illuminated fountains.

Holophane Globes. LEWES. *Elty*, Dec. 23.—A short extract from an article in the *Prog. Age*, Dec. 15, giving the results of some photometric tests with various globes used in connection with Welsbach lights. The observations were made for the angles from the horizontal to 45 degrees below it, and they show a gain or loss due to the shade or globe within that angle; a short table is reproduced showing that there was a gain of 12 to 13 per cent. for holophane globes, a loss of 7.5 per cent. for white opal globes and a loss of 11 to 12 per cent. for ground or frosted glass globes; for tinted glass the loss is serious; as the light is distributed more uniformly from a larger surface, sharp shadows are avoided.

Incandescent Lamp Filaments in Paris. Elec. Rev., Dec. 23.—In a note taken from a consular report, it is stated that the filaments for 20-cp lamps are worth $8,000 a pound, and for 30-cp lamps $12,000; for 3-cp lamps the filaments are so light that it would require nearly 1,500,000 of them to weigh a pound, and the total length would be 186 miles.

Electric Arc for Lantern Projection. HOPKINS. *Elec. Eng.*, Dec. 23.—A continuation of his article (see *Digest*, last week). He gives a detailed illustrated description of the Colt lamp.

Train Lighting. Elec. Rev., Dec. 23.—An abstract with the illustration of the article noticed in the *Digest*, last week, describing a system used in England.

Shunts for Alternating Arc Lamps. Amer. Elec., December.—In the case of a circuit of 19 series alternating lamps, each in parallel with a Westinghouse shunt coil, it was found that the reading of the voltmeter under normal circumstances was 49; with one of the lamps removed it became 47, and with the voltmeter on the shunt from which a lamp had been removed, the reading was at 150 volts. To account for the increased line voltage in the second case and the very high voltage of the shunt coil in the third case, it is explained that the magnetic circuit of the coil is not normally saturated; consequently, when the entire line current is forced through the shunt coil an E. M. F. is induced in it which is much greater than that under normal conditions, when a mere fraction of the line current passes through; the E. M. F. measured at the shunt in the third case is not in phase with that of the line, and therefore its effect on the line is less than represented by its numerical value, depending upon the angle of phase difference.

How to Make a Constant-Potential Arc Lamp. POOLE. *Amer. Elec.*, December.—Directions, with working drawings, for making what is stated to be a reliable and effective arc lamp for use on a 110-volt continuous-current circuit in series with a resistance of eight ohms; the necessary work can be done with a small screw-cutting lathe, a chuck, a few drills and other small tools, by any mechanic of average ability.

POWER.

Electric Ploughs. Lond. *Elec. Eng.*, Dec. 11.—A brief account of a recent trial in France, taken from a French journal. The source of power was an ordinary portable engine, the dynamo yielding 40 amperes at 500 volts; the plough contains a motor which works a windlass, around which passes a chain anchored at both ends; the speed is 75 yards per minute or about five times as fast as that with oxen; five acres were ploughed in 10 hours; thus 30 horse-power in steam did the work which would require 10 horses; the motor was fed by trolley lines.

Hydro-Electric System of Power Transmission. L'Elec., Dec. 12.—A short article stating that the Van Rysselberghe system has been tried in Antwerp with compressed air for some time, and is now to be abandoned for the regular electrical system. (As was stated in these columns some years ago, the principle of the system was that the resistance offered to water in pipes was inversely proportional to the fifth power of the diameter, while that to electricity in conductors is inversely as the square of the diameter; for this reason it was thought that it would be much cheaper to transmit the energy in the form of water under pressure than as electricity, transforming the water power locally into electrical energy and distributing it as such.)

Pawtucket Power Plant. Elec. Eng., Dec. 23.—An illustrated description is devoted almost entirely to the mechanical engineering features of the "upper station" in that city, which is located at a falls in the very centre of the city; it is intended to furnish light and power for manufacturing purposes; there is a steam reserve plant in connection with it; the dynamos are five in number, of a capacity of 150 killowatts each.

TRACTION.

Electric Automotors. FITZGERALD. Lond. *Elec. Rev.*, Dec. 11.—He gives some simple calculations to show what can be done by a modern accumulator, especially designed for traction, taking as a basis figures which he believes can be relied upon, namely, that one ton of the cells will yield 10,000 ampere hours, which at 1.9 volts is equal to 25 electrical hp-hours which is equivalent to 16 mechanical hp-hours; at the rate of seven miles per hour on a good, level road, this power will suffice for 11.4 hours, and the distance through which any weight of accumulators would transport itself would then be 80 miles; assuming the weight of the vehicle and passengers to be half a ton and with an equal weight for the accumulators and motors, the accumulators will weigh 0.4 ton and the power will be 6.4 mechanical hp-hours, or 1.3 horse-power for five hours, corresponding to a distance of 35 miles; the ratio of the useful to the total horse-power is 0.5. He then takes the case of a grade of 3 in 100; the power will then be 2.54 horse-power, the time 2.5 hours and the distance 17.5 miles. He therefore questions the claims of certain parties to be able to run 40 miles without re-charging; but if the ratio of useful work to total work is lower than 0.5 then it may be possible to store sufficient energy for over 40 miles; he questions whether this would be an economical solution of the problem.

Mechanical Traction in Paris. HILLAIRET. *L'Eclairage Elec.*, Dec. 12; more briefly in *L'Ind. Elec.*, Dec. 10.—A reprint of a short paper on the methods of traction used in Paris at present, showing how unsatisfactory they are; it includes brief criticisms of steam, compressed air, accumulator and surface contact systems at present in use in that city.

Review of Electric Traction. MARCHENA. Lond. *Elec.*, Dec. 11; a conclusion of the long abstract noticed in the *Digest*, Nov. 21.—He comes to the conclusions that at present it is technically possible to convert the steam railways into electric railways; that the initial cost of conversion would not necessarily exceed a small sum compared with the total capital outlay in the railways, and it may be assumed to have an average value of $10,000 to $12,500 per mile, and that the increase in traffic return and decrease in working expense will probably more than cover the interest and depreciation.

Traction Diagram. TOMLINSON. Lond. *Elec. Rev.*, Dec. 11; a continuation of the long serial noticed in the *Digest*, Oct. 31.—He continues the discussion of his formula for the mean brake horse-power accounted for in the speed curve of a traction diagram, and applies it to some recent tests in this country by Curtis and Pond.

Progress in Traction Motors. ZIFFER. *Elek. Anz.*, Dec. 3; a continuation of his serial.—In the present portion he discusses accumulator traction, giving some of the data of experimental and other lines.

Railway at Lausanne. BLONDIN. *L'Eclairage Elec.*, Dec. 12.—A brief description of this plant, in which compressed air was abandoned for electric traction, the power being obtained from gas engines run with power gas. Several other neighboring light and power stations are also briefly described.

Versailles. L'Energie Elec., Nov. 16.—A brief illustrated description of the electrical railway which was constructed by the Thomson-Houston Company.

Light Railway. Lond. *Elec. Rev.*, Dec. 11.—A brief description of a short line 4.5 miles long at Eaton Hall, having a capacity of 10,000 tons per year.

Compressed Air in Railway Work. ALDRICH. *Amer. Elec.*, December.—A summary account of the theory of compressed air working, in which the efficiencies at different pressures are calculated, and the necessity shown for reheating at delivery. Both of the methods of applying compressed air to street railway work are discussed—namely, charging at the station alone and at points along the line. The conclusion of the author is that compressed air may come to be the strongest ally of electricity rather than its avowed rival.

The Bonta Electric Railway Brake. Amer. Elec., December.—This brake is entirely electric in its action, and requires only a few additional contacts in the ordinary controller reversing cylinder. The principle is to connect the two motors of the car in such a way that one as a dynamo drives its mate in the reverse direction as a motor; this action will take place whether the trolley is on or not, and therefore the brake is operated under any conditions when the car is in motion and the motors are in good order. There are two distinct breaking influences, the back drag of the dynamo and the back torque of the motor; the braking action is so powerful that the brake is not intended for continuous use but rather for an emergency stop; a diagram shows the various connections when the brake is applied.

Electric Railway Motor Curves. Amer. Elec., December.—Efficiency, tractive effort, and speed curves are given for street railway motors, together with their method of calculation from test data.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Free Lamps. Lond. *Elec. Rev.*, Dec. 11.—A brief communication questioning the scheme suggested by GIBBINGS (see *Digest* last week). He suggests that the consumer will keep the new lamps until some of the old ones break, and they will therefore not consume the additional current which is to repay the station for the cost of the lamps; if they supply lamps of 4 or 4.5 watts per cp. the difference might be made up.

Installation Testing. ZINGLER. Lond. *Elec. Rev.*, Dec. 11.—The first part of an article giving, for those who are in charge of installation work, a methodical way of testing for and tracing out faults, earths and short-circuits; he will also give the principal causes, and suggest precautions and remedies. In the present portion he describes a systematic way of locating the circuit or portion of it where the fault lies, but it appears to contain nothing new.

Central Station Costs. Lond. *Lightning.*—This journal contains weekly four full-page tables giving an analysis of the accounts of the central stations in the United Kingdom operated by the municipalities and by companies; the tables seem quite complete and contain 33 columns of information.

Duesseldorf. Elek. Zeit., Dec. 10.—An abstract of some length from the report of that station for the year ending March, showing the cost of operation.

Electric Lighting of the Steamship "Dresden." Lond. *Elec. Eng.*, Dec. 11.—A brief, illustrated description of this plant, which is said to be a very complete one.

Equalizer System of Distribution. Churchward. *Elec. Eng.*, Dec. 23.—An article describing the Churchward system, which is claimed to have at least the copper economy of the three-wire system without some of its drawbacks; it has been in use in New York City for the past three years. It consists simply in using 250-volt dynamos and inserting an equalizer in the districts where lights are supplied; a third wire is run from this equalizer, forming the neutral wire of the three-wire lighting system, the motors being all run on the 250-volt mains; the equalizer is simply a dynamo with two armature windings and two commutators, which are connected as usual to the three wires, any unbalanced current acting as a motor current to drive the armature, the other half of which acts as dynamo; (it is not shown in what way this differs from the apparently identical system which has been in use for many years); the equalizer is generally made of a capacity equal to 10 per cent. of that of the total lamps on the circuit, although in actual practice 3 per cent. is rarely exceeded; he claims that the equalizer would cost much less in some plants than the third or neutral wire from the generator to the point of distribution. An application consists in compensating the drop in the line by a small series booster dynamo coupled with the revolving equalizer. In its application to factories it enables motors to be run at half the speed by connecting the armature between the neutral wire and one of the others, and the field to the outside wires; with a double commutator motor the speed can be reduced to one quarter.

Central Station. Elec. Eng., Dec. 23.—A short article by "Engineer" in reply to a recent article with the title, "Are Central Stations Doomed?" (See *Digest*, Dec. 12.) He gives the actual results of an existing station, which at first operated well, after which it was very unprofitable; it was recently improved and sold with a large profit. He concludes that it hardly appears that central stations are doomed, but that the prevailing methods of stock manipulation are, and that the sooner laws are enacted to prevent over-capitalization the better it will be.

Medical College Electrical Plant. Amer. Elec., December.—A description of the lighting and electro-therapeutic plant of the College of Physicians and Surgeons and Vanderbilt Clinic, New York City. There are two belt-driven generators and one direct-connected generator of an aggregate capacity of 130 kilowatts; a repair shop is provided, driven by electric power; the laundry machinery is driven by four direct-connected electric motors; the steam washing machine is given an oscillating rotating motion by a special gearing, the motor always running in the same direction; an ironing machine is driven by a 3.5-hp motor having the extremely low speed of 100 revolutions per minute; the college building is ventilated by 16 electric-motor fans. The Vanderbilt Clinic is supplied with a number of medical switchboards, from each of which faradic, galvanic and cautery currents may be taken; some of the switchboard outfits are also supplied with a motor to drive bone-saws, drills and various surgical instruments. A double-voltage dynamo supplies current to the various medical boards, one commutator supplying current at a voltage of 110, and another at 10 volts.

Alternating Current Regulators. Amer. Elec., December.—Description of the several means of regulating the voltage of alternators, with directions for correcting faults in the regulating apparatus; methods of compounding alternators are also described. The electro-mechanical regulator, which is described, is stated to be one of the most satisfactory; another method described is one involving the use of a small dynamo to excite the fields of the exciter.

WIRES, WIRING AND CONDUITS.

Calculation of a Three-Phase Transmission Line. Amer. Elec., December.—The calculation is based upon that of an ordinary direct-current line; the watts at the receiving end are divided by the voltage there, giving the current; the value of the current thus obtained is increased to take account of the inductance, that is of the power factor; with this final current, by the ordinary method the section of wire for a direct-current line is calculated and multiplied by two, giving the combined section of the two lines of the circuit; 75 per cent. of this value is then taken, owing to the saving of the copper entailed by the use of the three-phase system, and the result divided by three, which gives the required section of each of the three wires of the three-phase line. No allowance is made in this calculation for inductive line drop, as this depends upon the size of the line wire, the distance apart of the several wires and their relative arrangement; where it is necessary to take into consideration inductive drop, the calculation is stated to be quite complex; where over-excited synchronous motors are used their action is to nullify the inductive drop, so that in such cases the simple calculation above given is stated to be all that is necessary.

Interior Wiring. Amer. Elec., December.—The three-phase system is described and directions are given in regard to laying out circuits, in order that the two sides may be evenly balanced.

ELECTRO-PHYSICS AND MAGNETISM.

Distortion of Alternating-Current Waves. Eisler and Reithoffer. *Elek. Zeit.*, Dec. 10.—The first part of an article discussing the distortion of waves by means of unsymmetrical self-induction, including the subject of obtaining a direct pulsating current from an alternating one. If the magnetic circuit of a coil has a constant permeability, as for instance if it is air, the lines of force will be proportional to the current; the curve of the current necessary to produce a variation of the lines according to a sine curve will therefore also be sinusoidal and in phase with the curve representing the magnetism; it will differ from the curve of the current generated by a sinusoidal voltage in phase and amplitude, but not in form. If the material of the core has a variable permeability but no hysteresis, the sine form will no longer be retained; the curve is shown; it has a phase coincidence with the field symmetry between the two zero points, but will depart from the sine form. The third case is like the second, but the hysteresis is also considered; the current which will then be required to produce an alternating field varying according to the sine law will have a maximum there where the sine curve will be a maximum but the zero points will precede the others, the rising portion will be flatter and the designing portion more steep, while the maximum is not in the middle between the zero points; the curve is shown. In the above three cases the magnetic variations are assumed to be equal above and below the line; if, however, the zero line is no longer the symmetrical axis the positive and negative portions of the wave will no longer be equal; this is obtained by passing a continuous current through a separate coil around the same magnetic circuit; the positive maximum for instance of the current will then be greater than the negative, from which it might appear that in this way an approximately direct current might be obtained from an alternating one; the negative component might be made practically zero; Tesla has obtained a patent for this method, from which the present authors quote a portion and then show that the device described will give negative results; there must always be as much electricity flowing in the positive direction as in the negative; this they prove algebraically, showing that the quantity of electricity flowing in one whole period is equal to zero; the area of the positive half of the wave must be equal to the negative no matter what the position of the zero line, nor according to what curve the field varies, and it will be independent of the changing value of the self-induction; these results cannot be changed by the Tesla arrangement. By superposing continuous magnetization the curves lose the character of the usual alternating current curves; they may then have quite different positive and negative maxima, but by different durations of the positive and negative waves the unequal amplitudes are so compensated that as much electricity flows in the positive as in the negative direction; the article is to be concluded.

Hall Effect in Liquids. Bayard. Lond. *Elec.*, Dec. 11; noticed briefly from the *Jour. de Physique*, November; the conclusion of his research.—The effect was found to increase with the current with the magnetic field and inversely as the concentration; the distortion of the lines of flow is in the same sense as it is in bismuth.

Electric Oscillations of a Conducting and Polarizable Sphere. Kolacek. *L'Eclairage Elec.*, Dec. 12; translated from *Wied. Ann.*, 58, page 271.—A mathematical article of some length, in which he applies the Maxwell equations to a conducting and polarizable sphere in a perfectly insulating medium.

Electric Current. Silberstein. *Electrochem. Zeit.*, December.—The first part of an article of a theoretical nature discussing the "so-called electric conduction current."

X-Rays. Van Aubel. Lond. *Elec.*, Dec. 11; noticed briefly in the *Jour. de Physique*, November.—In an article on Becquerel's formula connecting the Faraday effect with the refractive index of the substance producing it, he also traces out the curious fact that transparency for heat rays and for X-rays are inverse properties, the one increasing whenever the other diminishes. It is thought hardly likely that this will be found to apply generally.

Velocity of X-Rays. Lussana and Cinelli. Lond. *Elec.*, Dec. 11; noticed briefly from the *Wied. Beiblaetter*, No. 10.—A note stating that they hope to determine it by rapidly rotating two lead-covered discs mounted on an axis parallel to the rays, at a distance of 60 cm apart; the discs have four holes in corresponding portions and when they are revolving rapidly the rays penetrating one hole will fail to pass through the corresponding one.

X-Ray Myths. S. P. Thompson. Lond. *Elec.*, Dec. 11.—A brief and very unfavorable criticism of a recent book on Röntgen rays in French by Charles Henry.

Discharge by Röntgen Rays. Perrin. *L'Eclairage Elec.*, Dec. 5.—A reprint, apparently in full, of the article noticed in the *Digest* last week.

Magnetic Permeability of Liquid Oxygen and Air. Fleming and Dewar. Lond. *Elec.*, Dec. 11.—A reprint in full of a Royal Society paper

describing in detail their method of determining the magnetic permeability and susceptibility, the method described having been adopted after many unsuccessful preliminary experiments. It consists briefly in using a small closed-circuit transformer like the usual ring transformers, only that the cross-section of the core was rectangular; the space for the core, which was left vacant, was then made to consist of liquid oxygen by dipping the coil into the liquid; in this way a comparison was made between the magnetic permeability while the coil was immersed with that obtained when it was raised out of the liquid into the gas immediately above it, at about the same temperature. With this coil a magnetizing force of over 200 units could be produced; the coefficient of mutual induction of the primary and secondary circuits is therefore altered by immersing the transformer in liquid oxygen; the vacuum vessel held two litres of the liquid oxygen; another induction coil was constructed in which it was possible to alter the mutual induction between the primary and secondary by small amounts by sliding one into the other; this was called the balancing coil, and was connected in opposition to the other through a galvanometer, which was then affected only by the difference between the E. M. Fs. of the two secondaries, permitting of a fine adjustment; the transformers were first balanced against each other and the first one was then immersed in liquid oxygen when a deflection of the galvanometer was produced. This method requires no calculation of any efficiency or mutual induction; the results of the tests are given in a table and the concluding value of the permeability is 1.00287, corresponding to a magnetizing force of 166 to 220 units. They have arranged another method which will give the magnetic susceptibility with far greater accuracy; it consists in observing the mechanical force which acts on a vacuum bulb when suspended in a vessel of liquid oxygen subjected to a variable magnetic field, in which case the tube will act like a strongly diamagnetic body, and with this method they expect to determine whether the permeability of liquid oxygen is a function of the magnetizing force. The magnetic susceptibility is about four times as great as that of ferric chloride, which is one of the most paramagnetic iron salts; the 12 per cent. manganese steel of Hadfield which is usually thought non-magnetic, has a permeability of 1.3 or 1.4. In conclusion they give the results with liquid air the permeability of which was found to be about 1.00240. The determination of the dielectric constant of liquid oxygen will also be made.

Curious Motion in a Crookes Tube. PECKHAM. *Elec. Eng.*, Dec. 3.—A brief description of an interesting observation. In a powerful Thomson double-focus tube, a thin, cup-shaped sliver of glass having a crescent shape, was inside of the tube, lying on its rounded side; it was about half an inch long and quarter of an inch wide; this suddenly began revolving, attaining a very high speed, then came to rest, stopping again and so on, stopping each time directly under the anode, followed by a leaping toward one of the anodes. This whirling indicates a greater intensity of action on one side than on the other; the sliver may have been bombarded by the material molecules; it fluoresced; he thinks it impossible that cathode streams were the cause, since they were focused on the anode about an inch above the piece of glass.

X-Rays Harmless When Generated with Static Machines. FREI. *Elec. Eng.*, Dec. 23.—A note stating that he has found that if a static machine is used instead of a Ruhmkorf coil no evil effects will be produced on the skin; the apparatus was even more powerful than the one used with the coil; he experimented with it for a number of weeks, perceiving no ill effects from it; he considers it as approved conclusively.

Magnetic Hysteresis. BERG. *Amer. Elec.*, December.—An account of the principles of hysteresis, with methods for the calculation of the losses due to it, together with curves from which to obtain the necessary data; numerical examples are included showing the increase of hysteretic loss with increase of voltage and increase of frequency. A method is given for determining experimentally the loss by hysteresis in alternating current apparatus, the only instruments necessary being an ammeter, a voltmeter and a wattmeter. A method is also given for separating the hysteretic and the eddy current losses.

ELECTRO-CHEMISTRY AND BATTERIES.

Alkali and Bleach by Chemical and Electrical Methods. BLOUNT. Lond. *Elec.*, Dec. 11, and begun in Lond. *Elec. Rev.* and *Elec. Eng.*, Dec. 11.; a reprint of a recent paper of a practical nature.—After calling attention to the fact that the success of a process depends entirely on whether it pays or not, he gives a comparison of the energy required for the conversion of common salt into sodium hydrate and chlorine by the Leblanc chemical process, and by one of the moderately efficient electrolytic processes; the theoretical quantities of heat are not considered, and he limits himself to those actually required in practice; the various stages of the chemical process are discussed, from which he finds that the consumption of coal per ton of salt-cake amounts to 1.5 tons, or per ton of soda ash, two tons; adding to this a small correction the total consumption for the production of one ton of 77 per cent. caustic is about 2.8 tons. For the electric process, assuming four volts and including the coal required for concentration, the coal used for one ton of caustic soda is 4.2 tons, and for sodium carbonate 3.2 tons, which quantities are greater than by the Leblanc process, but in the electrical one a corresponding amount of chlorine is evolved with no additional heat, while in the chemical process a further expenditure of fuel is necessary; adding a correction for the chlorine in the chemical process the total is 5.4 tons for caustic soda and chlorine, or 4 tons for sodium carbonate and chlorine; these figures are to be compared with 4.2 and 3.2 for the electric process; no pretension to exactitude is made, as the accurate data is not accessible. The decision on the processes cannot be based on the coal consumption alone; the grounds on which the electrical system is to be preferred are that no form of matter other than the salt and the water is necessary and there is therefore no waste product, while in the chemical process sulphur and nitrate of soda are needed in the first stage, of which the former may be recovered, but the nitric acid is lost; these waste products not only mean cost in themselves but necessitate a serious expenditure for handling and removing, while with the electrolytic process nothing but the final products need be carried away; there is also a saving of labor in the electrolytic process. On the other side the comparatively large cost of the installation and its high depreciation is against the electrolytic process; a large number of cells are required for even a moderate output; carbon is almost always used for the anode and neither it nor the diaphragms are yet satisfactory, although a good word is said for the use of mercury as an intermediate electrode. He quotes from a criticism of the recent article of Borchers noticed in the *Digest*, Oct. 17, in which he thinks the cost of water power has been underestimated; also that the profits of the electrolytic process have been hard to realize, owing to the high cost of the plant; there are also combinations of the products of the electrolysis producing various acids, if the diaphragm is too porous or the electrolysis carried too far; the liquid is also saturated with chlorine, and there is a large quantity of undecomposed salt associated with the product. He merely mentions the use of fused salt because the mechanical difficulties in constructing apparatus to withstand the sodium chloride at a red heat have proved to be most formidable, and have not yet been overcome; such a process will be handicapped by the necessity of supplying the energy for fusing, and for the waste of the energy necessary to get the sodium instead of the caustic soda. He discusses the subject of making caustic potash in place of the soda; in this the cost of the raw material is so much greater that the cost of the energy and labor becomes a smaller fraction of the whole and a clean and economical process is therefore of greater advantage; one electrical horse-power will produce with 4.4 tons of potassium chloride and 3.2 tons of lime, 3.3 tons of the caustic potash, and 5.2 tons of the chloride of lime; the cost of the raw material is four fifths of the total expenditure, and therefore an economy of the raw material is of greater importance; at 4 volts an expenditure of $175 for raw material and power would yield products representing a gain in value of $310. Perhaps the most promising of all electrical processes is the manufacture of potassium chlorate which is much simpler; in this the potassium chloride is electrolyzed and the products mixed forming potassium hypochlorite if cold and chlorate if hot; it is not known to what extent the manufacture of the latter by electrolytic processes is being carried on. There is a margin of some 50 per cent. at the disposal of the electro-chemist for improving the present processes for the industrial decomposition of common salt. In conclusion, he states that with the advent of a tolerably permanent plant, even with the present low energy efficiency, electrolytic processes will push the existing chemical methods hard; he does not think that the chemical manufacturers have yet come to the end of their tether.

Future of Electrolytic Alkalies. CARPENTER. Lond. *Elec. Rev.*, Dec. 11.—A brief quotation from a recent official report regarding the alkali industry in Great Britain. It is also stated that Hargreaves claims that for a given amount of electrical energy a greater agregate market value is produced when working for carbonate of soda and injecting carbonic acid into the empty cathode compartment, than when working for caustic; the carbonic acid is obtained from the exhaustion of the gas engine used to drive the dynamo.

Manufacture of Chlorine and Zinc from Blende. LYTE system. Lond. *Elec. Rev.*, Dec. 11.—A short note describing his system. The blende is roasted, the product is lixiviated with dilute sulphuric acid and the solution, after purification, treated with calcium or sodium chloride; after the separation of the calcium or sodium sulphate formed, the solution is evaporated to dryness and distilled, after which the chloride is heated high above the melting point of zinc and is then electrolyzed between an anode of carbon and a cathode of fused zinc; the chlorine which is set free is liquified and stored, the residual galena being then worked by the well-known processes.

Dissolving Gold in Chloride of Bromium. GAZE. *L'Eclairage Elec.*, Dec. 12; a brief description of a recent patent.—The solvent is prepared electrolytically; in a mixture of chloride and bromide of sodium are placed a number of porous cups filled with "pure water;" in the solution and in the porous cups are placed electrodes of carbon connected to a "powerful dynamo;" the vessel is closed with a cover; the chlorine and bromine generated by electrolysis combine immediately. In treating the mineral, it is immersed completely in the solution thus obtained, and submitted to compressed air at three or four atmospheres; the solution is then filtered and electrolyzed for the gold; the liquor can be used several times but it must be regenerated with the addition of soda and a subjection to the action of the current.

Electrolytic Zinc. Dieffenbach. *Zeit. f. Electrochemie*, Dec. 5.—A brief note stating that the problem of the deposition of zinc to any desired thickness seems to have been solved by this process, used at the Duisberg zinc works, for obtaining zinc from ores; the process is kept secret; 90 tons of zinc are obtained per month. That it is a financial success is shown by the fact that the plant is to be enlarged during the present year.

Copper Deposits. Elmore process. *Zeit. f. Electrochemie*, Dec. 5.—A brief description of an improvement to be used in depositing copper in the form of tubes, by the well-known Elmore process; the anodes are placed as close as possible to the cathode and the electrolyte is forced between the intervening space, so that it circulates very rapidly, enabling a high-current density to be used without affecting the density of the deposit.

Deposition of Gold and Silver. Andreoli. *Zeit. f. Electrochemie*, Dec. 5.—For depositing these metals from the cyanide solution he recommends peroxide of lead anodes, claiming that thereby he has found that the solution remains clear and is not made impure by salts of metals.

Corrosion of Zinc Plates. Mylius and Funk. *Zeit. f. Electrochemie*, Dec. 5; noticed briefly from a chemical journal.—The zinc anode is often corroded deeply in small spots; they endeavor to find the cause of this. When cast zinc was first washed in alcohol this did not happen, and it was therefore thought to be due to the oil on the surface; rolled sheets behaved in a like manner, but the corrosion is not avoided by washing in alkali; with zinc containing lead a sudden chill when they are cast, as also mechanical manipulations, prevent this corrosion largely, but the mechanical manipulations have no effect on pure zinc.

Copper Plating Aluminum. Elek. Anz., Dec. 10.—A note taken from another journal, describing a process which is briefly as follows: The objects are first dipped into potassium or sodium carbonate, and after a thorough washing are dipped into dilute hydrochloric acid; after another thorough washing they are dipped into a dilute and slightly acid solution of copper sulphate until a copper deposit is formed on them; after again washing very thoroughly to remove all the chlorine, they are placed in the bath and plated with a current. Another process by Nees is given: The articles, free from greases, are immersed in sodium hydrate until gas is evolved, then without washing they are dipped for a few minutes into a solution of five grains of chloride of mercury in one liter of water. They are then again dipped into the first solution, and without washing are placed in a silver bath for plating.

Properties of Intermediate Conductors. Kauffmann. *Zeit. f. Electrochemie*, Dec. 5.—A brief discussion of some of the actions of such conductors, including some calculations of their effects on the distribution of the current (by these intermediate conductors he means conducting plates placed in an electrolyte through which a current is passing but not connected with the electrodes); the calculations apply to spheres and cylinders.

Electrodes. Weyer. *Electrochem. Zeit.*, December.—A conclusion of his summary, in which he gives brief descriptions of recent improvements in electrodes for batteries and electrolysis.

Contacts for Carbon. L'Eclairage Elec., Dec. 5.—An illustrated description of a method in which, in a hole drilled through the carbon, a thin tube of platinum is inserted and is then filled with a fused alloy which expands on solidifying; to this the terminal is then soldered.

Progress of Electrochemistry in 1895. Elek. Anz., Dec. 10; a continuation of the summary noticed in the *Digest*, Nov. 14.—In the present portion the metals are discussed.

Electric Furnace for Metallurgical Purposes. Borchers. *Zeit. f. Electrochemie*, Dec. 5.—A continuation of his illustrated descriptive summary; the present portion deals with those in which an arc is formed.

Electric Distillation Furnace. Zeit. f. Electrochemie, Dec. 5.—An illustrated description of a new form of laboratory apparatus for the distillation of metals.

Accumulator. Zacharias. *Electrochem. Zeit.*, November.—He claims that the destruction of the plates of an accumulator is largely due to the gases formed in the pores of the material; the harder and denser the active material is, the quicker and more surely will be its destruction; the way to avoid it is to provide means for the escape of the gas, and for this purpose he pricks the active material with needles at the rate of 100 holes per square decimetre. He claims that in many cases the negative plate is more difficult to construct that the positive on account of this action of the gas. In his plates there are no metallic parts running in a horizontal direction; the metal frame does not prevent expansion of the active material or the evolution of the gas; such plates begin to evolve gas much sooner, but only in the form of very small bubbles; the capacity is about 35 ampere-hours per kilogram of electrodes; there is claimed to be no tendency to sulphating and the material does not drop out.

Accumulators. Gruenwald. *Elek. Anz.*, Nov. 22 and 29.—In the first article he gives a brief review of a few of the many methods which have been suggested for making a durable active material for accumulators. He states that the problem of making a very hard, very porous and well conducting mass, is still to be solved and will remain unsolved. In the second portion he discusses some of the methods which have been devised for keeping the plates apart.

Liquid for Batteries. Elek. Zeit., Dec. 10, and *Elek. Anz.*, Nov. 22.—A note stating that a more active exciting fluid for batteries can be made by adding oxychloride of calcium to the salammoniac; this material in solution does not dry out in Summer, does not freeze in Winter and does not crystallize out. Tests have shown that the evaporation is very small, although the cells were put in a warm place; the solution has only a very slight resistance and the polarization is small; the tests were made first with the pure oxychloride of calcium, in which salammoniac was dissolved; then with oxychloride which was first diluted with two parts of water; both gave equally good results; the material is quite cheap.

Formation of Silicates. Mayencon. *Elek. Anz.*, Dec. 3.—A brief abstract of a recent article by him in which he states that silicates will yield at the anode soluble fluoric acid; by this means he decomposed insoluble silicates; they were pulverized and mixed to a paste in water, then placed on a metal plate, covered with filter paper and another plate, after which they were subjected to the current, the lower plate being the negative one; in this way he experimented with talc, mica and black tourmaline. It is stated that such an action may therefore be presumed to take place in accumulators in which silicates are used as separators.

Electrolysis of Salts and Bases in Ammonia. Losanitsch and Jovitschitsch. *Zeit. f. Electrochemie*, Dec. 5; a brief abstract from a paper from a Servian journal.—In such electrolyses in which hydrogen is evolved on one pole and nitrogen on the other, there will always be less nitrogen than the amount corresponding to the hydrogen; they endeavor to find the reason for this.

Electrolysis of Water. Sokolow. *L'Eclairage Elec.*, Dec. 5; translated from *Wied. Ann.*, 58, page 209, reprinted in abstract in the *Zeit. f. Electrochemie*, Dec. 5.—He describes experimental researches to determine the following: to prove directly that water is decomposed by a voltage however low; to determine the pressure which the gas requires when generated by a calomel cell; to determine a certain constant concerning the first appearance of gas bubbles; and to study the phenomena of the retardation of the electrolysis.

Theory of the Migration of Ions. Hargreaves. *Electrochem. Zeit.*, December.—A note stating that he believes his hypothesis of the unidirectional migration of ions will agree better with most of the experimental observations than the one usually accepted, but he does not claim that this theory is absolutely correct.

The Arrhenius Theory. Kuester. *Zeit. f. Electrochemie*, Dec. 5.—The first half of a paper pointing out the application of this theory of splitting of the ions in analytical chemistry.

Production of Copper and Other Metals from the Ores. Hoepfner process. *Eng. & Min. Jour.*, Dec. 19.—A short description of this patented process, which has recently been greatly improved. The powdered ores are leached with a warm solution of perchloride of copper, containing also chloride of sodium or calcium; this extracts the silver, copper, lead, bismuth and some iron and arsenic; the solution containing cuprous chloride is first freed from its silver by metallic copper, from the chloride of lead by cooling, and from the antimony, bismuth and arsenic by powdered limestone; the iron is separated out by exposure to the action of the air; the purified solution is then electrolyzed; "this solution is divided into two separate currents, of which one, brought in contact with the cathode, loses all or part of its copper contents, while the other, brought in contact with the anodes, is re-converted into a solution of cupric chlorides"; after leaving the bath the currents are re-united again, making the original solution, thus forming a perfectly circular process; some of the other impurities will be deposited out in the electrolytic bath. An essential feature is that 1000 amperes precipitate 2360 grains of copper per hour from cuprous chloride solutions, which is twice as much as that deposited from the usual sulphate of copper, thus reducing the cost of the installation greatly; the process requires only 0.5 to 0.7 volt and the conductivity is much better than that of the sulphate; per day and per horse-power more than 100 pounds of copper can be deposited directly from the ores, requiring not more than 100 pounds of coal. Calculations show that the cost of extracting one ton of pure electrolytic copper per day from ores containing not more than 5 to 10 per cent. of copper is not more than $38 and as the selling price of electrolytic copper is about $25 higher, the cost of the process is said to be only $13; the recovery of the silver is sufficient to cover the total cost of extracting both the copper and the silver. The process extracts neither the gold nor the whole of the zinc.

Electric Furnace for Reducing Iron. Elec. Age, Dec. 19.—A short note regarding the project of De Laval in Sweden, which has been noticed before in these columns, in which it is intended to erect large electric furnaces, the energy being obtained from some large water power; it will be used for the conversion of iron ore into pure metallic iron or steel in one operation; at present it usually takes two operations, one to eliminate the impurities associated with the metal as found in the earth; instead of producing pig iron first and then converting this into iron or steel, the two processes are combined into one in the present project. It is stated that the object of the furnace is merely to produce heat and nothing else.

Alkali and Bleach by Chemical and Electrical Methods. BLOUNT. *Elty*, Dec. 23.—The beginning of a reprint in full of the paper abstracted above.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Quartz Fibres. BOYS. Lond. *Elec.*, Dec. 11.—The first part of an article describing, in considerable detail, and with the aid of some illustrations, the essential practical details of the method of making and applying quartz suspension fibres (with which that author has been so very successful); much of the matter is scattered through different articles by that author, but this is the first complete description. The article does not admit of being abstracted and therefore only a general idea can be given here. The first process is to prepare sticks of quartz which has been fused once; he uses only the clear transparent variety; on heating it the first time it is very apt to fly all to pieces when introduced into the flame; when it has once been melted it never cracks again; the fusing may be started by taking two small pieces in pliers and bringing them into the margin of the oxyhydrogen flame, care being taken to avoid heating the pliers as the iron combines with the quartz; when the ends becomes fused they are readily stuck together and a stick may then be built up; in this way it does not take many minutes to make enough quartz for a few miles of fine fibre; after making a rough stick it should be re-melted and drawn out into a clear glass-like rod from one to two mm in diameter; when very fine fibres are required of short length it is sufficient to stick two pieces together in the flame and draw them apart with a fairly rapid but not sudden movement, when a thread, perhaps a yard long, will be shot out by the flame; this will be too fine for the majority of purposes. He then describes with illustrations the method of shooting the fibres with a bow and an arrow of straw, the fragments of quartz being connected to the rear end of the arrow and held in the flame, where it is stuck to another piece which is stationary, the arrow being shot off at the proper moment without withdrawing the jet; in this way fibres of any intended thickness accurate to 0.0001 inch can be made; instructions are given for making them any desired thickness and for winding them on frames.

Measurement of the Clark Cell with the Helmholtz Electro-Dynamometer. KAHLE. *Zeit. f. Electrochemie*, Dec. 5; abstracted briefly from *Wied. Ann.*, 59, page 532.—He gives a description of the instrument and its calibration suggested by Helmholtz, in which the current is measured by the torque exerted by two coils at right angles to each other, the torque being measured by a weight; most of the article seems to be devoted to a description of the instrument; in conclusion he gives the result of a measurement of the H-form of Clark cell; for zero degrees, 1.4488 absolute (not legal) volts, and for 15 degrees, 1.4322.

Cadmium Standard Call. JAEGER and WACHSMUTH. *Zeit. f. Electrochemie*, Dec. 5; abstracted briefly from *Wied. Ann.*, 59, page 575.—The H-form of cell was used; a comparison with the Clark cell measured by Kahle (see above) gave a mean of 1.019 international volts at 20 degrees; the temperature coefficient is about 20 times as small as for the Clark cell; after great temperature changes they quickly recovered their normal value; the impurities of the commercial cadmium and the sulphate have only a small influence on the voltage; the cell is easily reproduced; the constancy of the cell was found in two years' tests to be as good as that of the Clark cell; the cells did not suffer from being transported through the mails.

Standards of E. M. F. ARMAGNAT. *L'Eclairage Elec.*, Dec. 12.—An illustrated description and discussion of the various standards, being a sort of brief treatise on the subject, and forming one of the articles of a very good series in that journal on electrical measuring instruments.

Polarization by Alternating Currents. WIEN. *L'Eclairage Elec.*, Dec. 5; translated from *Wied. Ann.*, 58, page 37; reprinted in abstract in *Zeit. f. Electrochemie*, Dec. 5.—He discusses at some length what happens when an alternating current passes an electrolyte, the purpose being apparently to point out the errors which arise in the Kohlrausch method of measuring the resistance of electrolytes. An electrolyte behaves toward an alternating current like a resistance in series with the capacity; in some cases these are independent of the density of the current; when the electrolyte has a specific inductive capacity the electrolyte acts like a resistance with a capacity in deviation with it and another in series with it.

Measurement of Electrolytic Resistance. KOHLRAUSCH. *L'Eclairage Elec.*, Dec. 5; from *Wied. Ann.*, 58, page 514; a reply to the above article by Wien.—He claims that the errors pointed out by Wien have not the importance claimed, except in extreme cases; the corrections are always less than 0.001 when the resistances measured are not below 100 ohms.

Influence of the Surrounding Atmosphere on the Hefner and Pentane Lamps. LIEBENTHAL. *L'Ind. Elec.*, Dec 10.—A French translation by Boistel, of a large portion, including the curves, of the article which was noticed in the *Digest*, Nov. 2 and Dec. 21, 1895.

Photometric Units. BLONDEL. *Zeit. f. Beleucht.*, Nov. 30.—The beginning of a German translation of his Geneva Congress paper (see *Digest*, Sept. 5 and 26).

Measurement of the Insulation Resistance of Street Railway Cables. UPPENBORN. Lond. *Elec. Rev.*, Dec. 11.—A note stating that the method recently described by HEWITT (see THE ELECTRICAL WORLD, Oct. 31, p. 515,) is by no means novel, as the present writer described it in 1888 and every year since then, in his well-known "Pocketbook for Electricians."

Voltmeter Measurement of Insulation Resistance. HALE. *Amer. Elec.*, December.—A description of a simple method of measurement of the insulation resistance with a voltmeter whose constant is known, the constant being the resistance corresponding to a deflection of one scale division. If, for example, the resistance is 60,000 ohms for a voltmeter having 500 divisions, the constant is 60,000 times 500, or 30 megohms; the deflection of 50 divisions will therefore indicate a resistance of 600,000 ohms, or, substracting the resistance of the instrument, to an insulation resistance of 540,000 ohms.

Method for Measuring Resistance. BEINHORN. *Amer. Elec.*, December.—The method consists in finding two points on a rheocord at which equal deflections are indicated on a galvanometer connected in circuit with the resistance to be measured; the arrangement of the resistance to be measured and other parts of the circuit are such that the desired resistance is obtained by a proportion including the lengths of the rheocord intercepted by the contact points. In the practical application of the method a rotary commutator is used, by means of which the needle of the galvanometer is brought to rest midway between the above two points.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraph Statistics. Lond. *Elec. Eng.*, Dec. 11.—An abstract of the statistics for various countries for 1895, from the *Jour. Telegraphique.* Germany leads with length of line, which is 132,000 km; next comes France with 93,000, and the United Kingdom with 59,000; Germany has 490,000 km of wire, France 317,000 and the United Kingdom 369,000. The proportion of Morse to other systems in Germany is 16 to 12, in France 12 to 6 and in the United Kingdom 5 to 23. In Germany there were 24,000,000 paid messages, in France 34,000,000 and in the United Kingdom 70,000,000; the lines are therefore worked more in the United Kingdom than anywhere else.

Induction in Multiple Core Cables. PREECE. Lond. *Elec. Rev.*, Dec. 11.—A brief reply to Dresing, stating that the whole principle of shielding conductors in multiple cables from the effects of electrostatic induction was developed by him (Preece) in 1878, as shown in the *Phil. Mag.*, April, 1878, and tinfoil was used for that purpose in that year in the streets of London.

Trunk Telephone Lines. PIERART. Lond. *Elec. Rev.*, Dec. 11.—A brief discussion (in French) of the recent paper by GAVEY (see *Digest*, Dec. 5, 12, 19 and 26), in which he questions the statement that the current curve is flattened by the electromagnets of the receiving instruments; in practice he has observed that the action is not precisely as described, and gives the results with a shunted condenser at the Brussells station.

Telephone Relays. Lond. *Elec. Rev.*, Dec. 11.—A short editorial note arguing that unless the diaphragm of a receiver can be made to vibrate with an amplitude somewhat approaching that of the transmitter, telephone relaying seems to be impracticable.

Railway Block Signaling. PIGG. Lond. *Elec. Eng.*, Dec. 11.—A continuation of the serial which has been running through the columns of that journal, in which he gives illustrated descriptions of the systems in use.

Reminiscences of Edison. PHILLIPS. *Elec. Rev.*, Dec. 23.—Some brief reminiscences in connection with his quadruple system.

The Telephone Receiver. MILLER. *Amer. Elec.*, Dec.—The principles of the telephone receiver are given, with illustrations and descriptions of a compound and a bipolar magnet receiver and the Ader bipolar receiver. The author does not agree with the opinion of an eminent English authority that the tendency of the telephone should be toward decreasing rather than increasing the sensitiveness of the receiver, as this would seem to be simply avoiding one fault by creating another; the proper remedy, he believes, lies in eliminating the disturbances affecting delicate receivers rather than in attempting to reduce their effect by decreasing the sensitiveness of the instrument.

MISCELLANEOUS.

Gutta Percha in French Soudan. *L'Elec.*, Dec 11.—A note stating that a creeping plant has been found which gives true gutta percha; the gum can be collected all the year around, but is best obtained from the green fruit; the latex gives from a quarter to a third its weight in raw gutta percha; the material is found to have every property of gutta percha (the same note also states that it is true gutta percha); the colony can produce 100 tons per year.

Electric-Pneumatic Brake. CHAPSAL system. *L'Ind. Elec.*, Dec. 10—An illustrated description of a system used in France. The objection to the purely pneumatic system, such as the Westinghouse, is the slow speed of transmission along the train, of the force to operate the brakes; with the present electrical system all the brakes are applied simultaneously, and it enables two systems of braking to be used, one pneumatic and the other electric; it involves but insignificant changes in the Westinghouse apparatus.

Electric Preparation of Welsbach Mantles. *L'Ecairage Elec.*, Dec. 12.—A brief illustrated description of the Voelker process, in which the electric furnace is used; the description is very brief and not very clear.

Mechanical Applications of Electricity. Richard. *L'Eclairage Elec.*, Dec. 12.—A continuation of the long serial appearing in occasional numbers of that journal, giving brief but well illustrated descriptions of various devices, taken apparently from patent specifications. The present one includes the mechanism of several different electrical elevators, traveling cranes, etc.

Geneva Exhibition. Guye. *L'Eclairage Elec.*, Dec. 5 and 12.—Illustrated descriptions of some of the apparatus, one of which is the regulator for series motors described above; another is an apparatus for operating the regulating cells in a series of accumulators; another is a centrifugal pump for high pressure; a brief description is given of the electrical kitchen.

Berlin Exhibition. Elek. Zeit., Dec. 10.—A continuation of the illustrated description of the electrical exhibits.

Biographical History of Electricity.—Sir Humphrey Davy is the subject of the current installation of this series. It is stated that his real fame rests almost entirely upon the invention of the miners' safety lamp and his work as an electro-chemist, and that Davy, in fact, never appears to have claimed to be the first to produce the electric arc; his brilliant experiments with the latter in 1809 and subsequently, which were witnessed by great audiences, apparently having given him that popular reputation. Davy incidentally described the electric arc in 1808, in a lecture detailing some electric experiment which he had made with carbon in its several different forms.

The Digest for 1896.—During the past year the number of journals abstracted in this department was 1720, averaging over 33 per week; of this, 961 were foreign and 759 American. The number of abstracts and references was 3333, averaging over 64 per week; as a rule the abstracts were longer than during the previous year and there were fewer mere references. The largest number in one group was 711, under Electro-Physics and Magnetism, of which 533 were on X-rays, cathode rays and vacuum tubes in general; next comes Traction with 438, followed by Electro-Chemistry with 316.

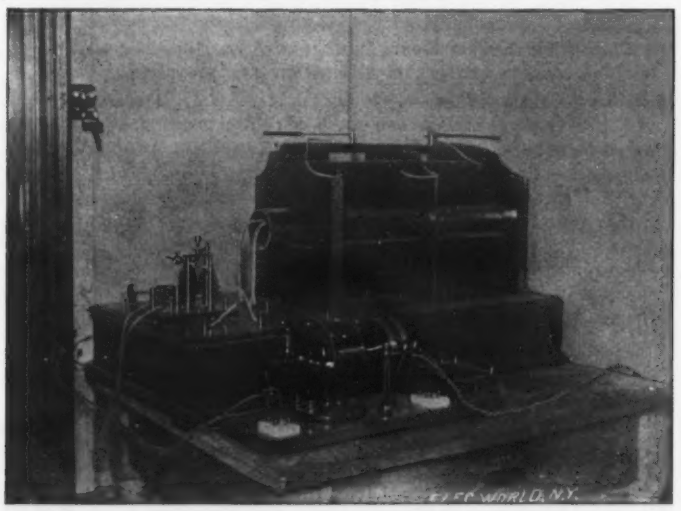
Röntgen Rays in the Orthopædic Dispensary and Hospital.

Although it was early recognized by hospital authorities that apparatus for the production of Röntgen rays might prove a valuable acquisition for the purpose of diagnosis, the adoption of such has not been very extensive in the hospitals of this country, owing probably to the fact that the doctors have as yet not found an opportunity to get as successful results as those obtained by more experienced investigators. The tendency, however, for the adoption of Röntgen rays in hospitals is increasing, and the latest acquisition in this direction has been the complete equipment which has recently been installed in the Orthopædic Dispensary and Hospital of New York City.

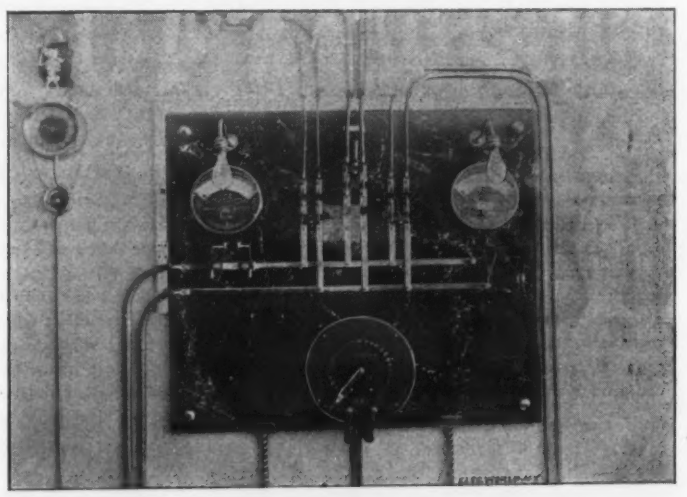
A small dark room has been set apart on the main floor of the building, and here has been installed a modern Röntgen-ray equipment having both an automatic vibrator and a motor rotary break. The induction coil gives an 8-inch spark, the primary of the coil being supplied from a storage battery consisting of six chloride accumulator cells of 100 ampere-hours capacity and from the lighting circuit of the hospital. The circuits are so arranged that either the lighting or storage-battery circuit may be used alone, or the two in parallel, the latter being the most desirable, assuring a strong, steady current, which may be supplied through either the automatic vibrator or motor break. The coil has the usual condenser which is used with the automatic vibrator, while an adjustable Marshall condenser of 360 microfarads capacity is used to reduce sparking at the brushes of the rotary break. A bank of lamps placed outside the operating room is used as a rheostat control for the 110-volt lighting circuit. Several focusing tubes of different types have been added to the equipment, and the whole was installed in a most careful manner by Mr. Willard M. Miner, for the manufacturers, J. Jones & Son, 67 Cortlandt Street, New York, represented by Mr. Charles W. Leveridge.

A new marble switchboard has been placed in the engineer's room and is fitted with the circular type of Weston ammeter and voltmeter. As will be seen in the accompanying illustration, there are three switches, one on the left supplying the current to the neurological room where the electro-therapeutic apparatus is operated, including the latest methods of massage treatment. The centre switch supplies current for the Röntgen ray room, while the one on the right supplies the shop, laundry, kitchen and engine rooms. The new extension to the building which was opened last week is wired throughout and may be supplied either from the hospital lighting circuit or from the street service. There is a complete shop equipment for the manufacture of braces and other instruments, 12 mechanics being employed under the supervision of Mr. John Schum, chief engineer of the hospital. The latest system of ventilation has been installed by the Nason Manufacturing Company, New York City, and includes a 12-inch blower fan of latest type, run by a 20-hp vertical engine. The fan forces a current of air into a chamber containing steam-heated coils, and passing through which the temperature is raised. It is then supplied to various wards of the hospital through flues which all enter the same room in the cellar. Each flue has a separate steam coil for the purpose of increasing the temperature if desired. This method of ventilation has the most desirable feature of not requiring the opening of windows of the hospital either in Summer or Winter. The installation of the Röntgen ray apparatus, and in fact, all the equipment of the hospital, has been due to the progressive efforts of Dr. Newton M. Schaffer, surgeon-in-chief, and the generosity of one of the trustees, Mr. Edward A. Smith.

Methods of Operating.



Induction Coil, Rotary and Automatic Breaks.

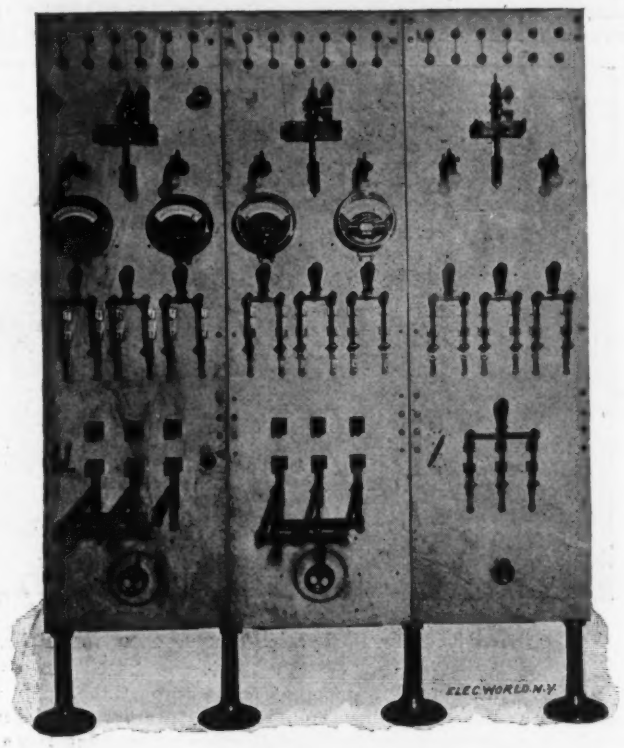


Switchboard.

An Economical Plant.

One of the largest shoe factories in this country and perhaps in the world is that of the Krippendorf & Dittman Company, of Cincinnati. O. This concern occupies a seven-story building in the heart of the city, 100 feet front by 200 feet deep, and employs some 1500 hands.

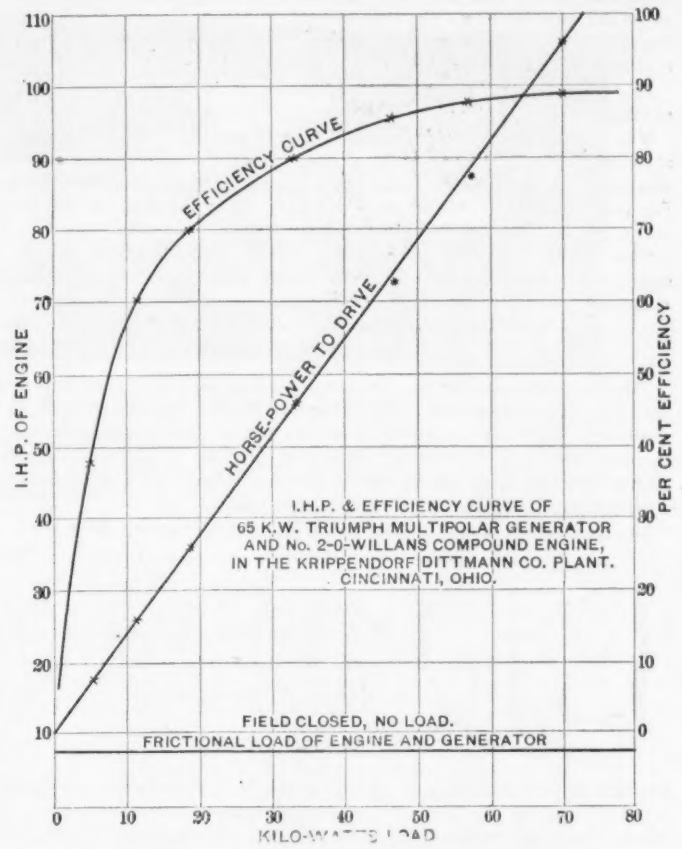
In most of the mechanical operations it is necessary for its employees to have light directly on their work; this was formerly supplied by a gas



SWITCHBOARD.

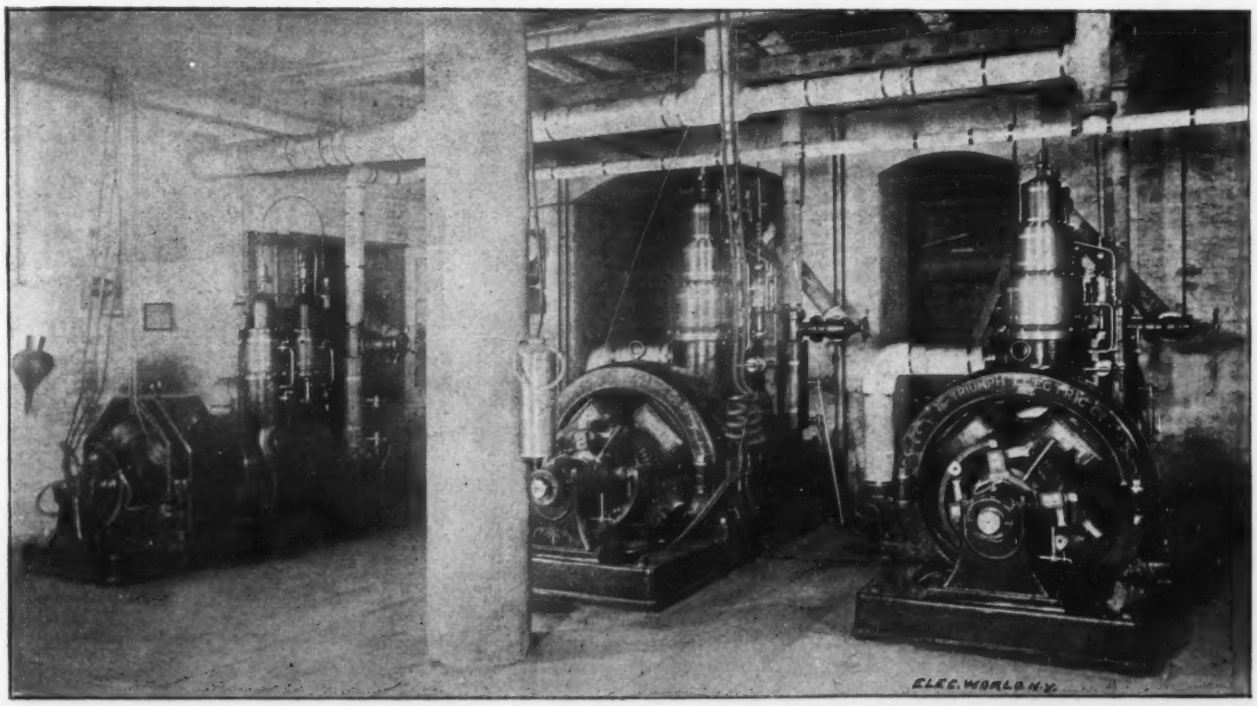
jet at each bench or machine, and as there are some 600 machines on a floor, the amount of gas used was enormous. Besides using gas for light it was also employed for heating glue pots, irons, etc. As a result of careful investigation the management decided, in the interest of economy, to install an electric plant and furnish their own light and heat as far as practicable by electricity.

stands and measures over all 93 inches by 98 inches. It is constructed of three equal panels, one for each generating set. Each generator is protected by a Westinghouse automatic circuit-breaker; Weston round pattern instruments are used, there being one ammeter for each machine and



EFFICIENCY TEST.

one voltmeter for the three, connected by a three-point switch to any one. There are nine feeder switches, three on each panel, and one main dynamo switch for each machine. The rheostats are mounted at the bottom of the board. The 65-kw generators and the switchboard were installed by the Triumph Electric Company, Cincinnati, O., the engine being furnished and installed by the M. C. Bullock Company, of Chicago.



GENERATING PLANT IN A CINCINNATI SHOE FACTORY.

The boiler plant consists of two Stirling water tube boilers each of 250-hp capacity, two 130-hp Willans vertical double compound engines directly connected to two 65-kw Triumph generators, and one 70-hp Willans simple engine directly connected to a 35-kw Western Electric generator. The switchboard is of white Italian marble mounted on nickel-plated

With each engine was furnished a Schaeffer & Buddenberg steam gauge attached to the steam chest.

On Dec. 4 readings were taken from generating set No. 2 (Triumph generator). The speeds were taken with a Schaeffer & Buddenberg tachometer, amperes and volts were read from switchboard instruments

which are guaranteed correct within 1 per cent. and the no load readings were taken at the end of the run.

Plotting these readings, using ordinates for efficiency and abscissæ for kilowatts power the efficiency curve on preceding page results. On the same diagram is shown the line of I. H. P. for any load and corresponding efficiency. This curve will compare very favorably with the best efficiency curves taken from much larger sets.

In connection with the above efficiency it is interesting to note the saving effected by the installation.

The former gas bills were about $550 per month, running in some instances to $650. The total cost of operating the electric plant is $216 per month as against $550, representing a saving of $334 per month, or $4000 per year, at which rate the plant not only earns interest on the investment, but will pay for itself in about five years.

The Krippendorf & Dittman Company is highly pleased with the results, and takes pleasure in giving credit both to the Triumph Electric Company and the M. C. Bullock Company.

The Churchward Equalizer.

This machine was designed to furnish a simple and economical device for balancing a three-wire circuit supplied by one dynamo or dynamos in multiple. The many objections to the use of two generators for the three-wire system, as generally installed, have led to several attempts to secure the line economy of this method of distribution with only one dynamo furnishing current to the outside mains.

Mr. A. Churchward, of the Excelsior Electric Company, New York, has

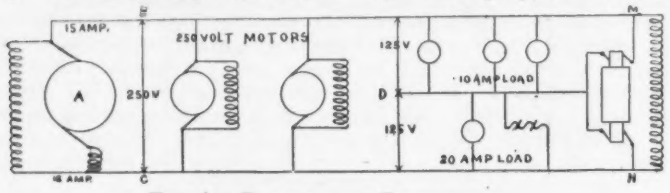


Fig. 1.—Diagram of Connections.

brought out for this purpose a novel type of motor-generator or equalizer which has stood the test of commercial operation for three years with marked success. It consists of an armature having two equal and symmetrical windings connected to two commutators, one at each end. This runs freely in a field which is excited from the outside mains. One set of brushes at each end is connected to the outside main while the other two are connected together and to the middle, or neutral, wire of the three-wire system.

If the system is in balance the armature revolves, taking only the small amount of current necessary to keep it moving. If the system now becomes unbalanced and an excess of current is required by one side, the result is that this excess flowing through one winding of the armature causes it to become a motor and the other side becoming at once a dynamo furnishes the necessary current to its half of the working circuit.

Fig. 1 illustrates this action more clearly. Here the source of current is a 250-volt generator *A*, supplying the mains *B* and *C*. *D* is a middle or neutral wire, used only in the district where it is required to furnish 125-volt-current. The equalizer is shown at *M N*. If the circuits are unbalanced, as indicated, with 10 amperes between *B* and *D*, and 20 amperes between *D* and *C*, then 15 amperes, at 250 volts, will be required from the

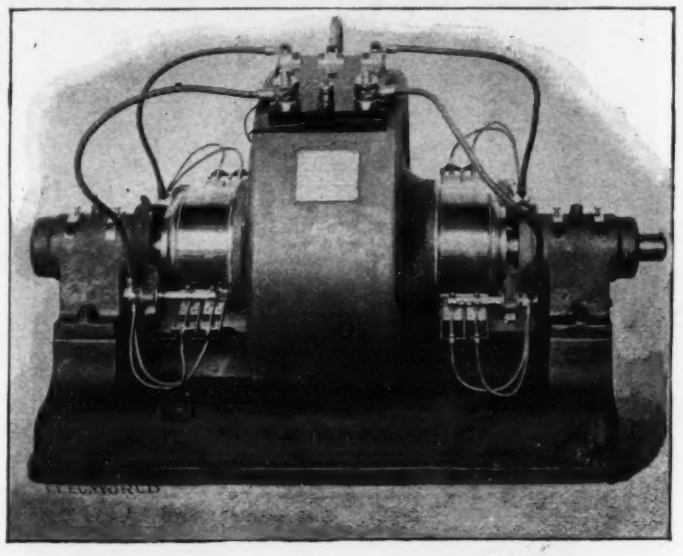
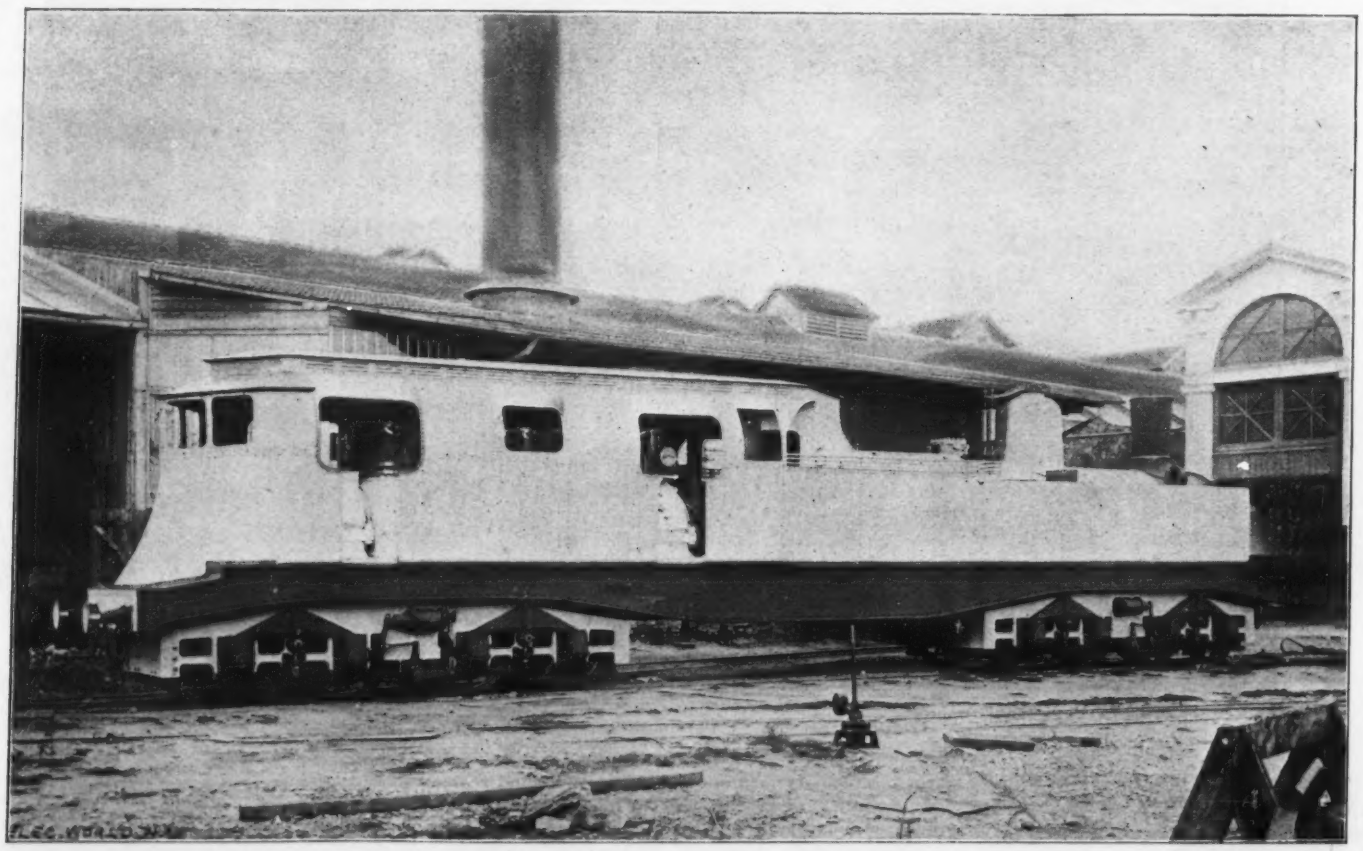


Fig. 2.—100 KW Equalizer. Capacity, 2000 16 CP Lamps.

generator. From *B* to *D* 10 amperes will flow through the lamps, and the remaining 5 amperes will flow through the armature winding of that end of the equalizer connected to *B* and *D*. This at once becomes a motor, driving the remainder of the armature winding as a dynamo and supplying to the circuit *D C* the necessary 5 amperes to complete the 20 required by its load.

By this method the equalizer practically takes power from the outside mains and distributes it to preserve the balance of the system. In practice it has been found sufficient to make the capacity of the equalizer one tenth of the total load of lights on the circuits.



Newest Type of Heilmann Locomotive. (Described in The Electrical World of Oct. 24, 1896.)

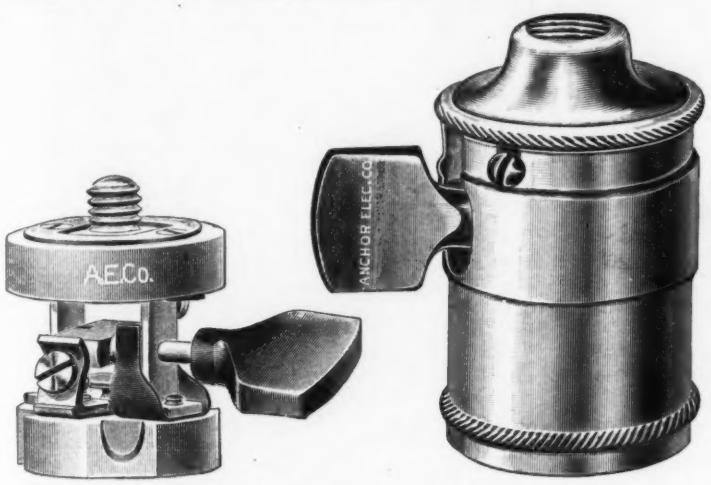
There is in this machine only one field loss, one loss due to hysteresis and eddy-currents, and only one pair of bearings. Since the armature windings are necessarily opposed to each other there is no field distortion, no change of speed, and no sparking with change of load. The load limit of the machine is therefore the carrying capacity of the armature wires.

By attaching a small series-dynamo to the shaft of the equalizer, it is possible to first "boost" the pressure of the circuit and then divide and equalize it in the same manner. It is, of course, easily feasible to operate the machine at other pressures than those mentioned above.

The equalizer system has been operated for three years on a 1200-kw central station in New York City with very satisfactory results.

Socket of New Design.

The Anchor Electric Company, Boston, Mass., has made an innovation in socket design. Instead of keeping in the procession in turning out cheaper and cheaper sockets, after the limit of price at which a serviceable article can be made has long since been passed, it has branched off and produced a higher-priced socket, which, however, is fully worth the price asked for it. The device is designed to meet the demand for an extra strong and durable socket, and is especially adapted for fixture work. The shell is heavy, the neck cannot be easily broken off, and all parts are made to ensure extra strength. The accompanying illustrations represent the interior mechanism of the socket and the socket complete. The device as thus shown has a very substantial appearance.



EXTRA STRONG LAMP SOCKET.

High-Potential Insulators.

The increasing use of high-potential currents for long-distance transmission of power has naturally necessitated great improvements in the insulation of the lines, and among the concerns and individuals most successful in meeting this condition is Mr. Fred M. Locke, Victor, N. Y.

At various times in the past we have prepared for the information of the trade descriptions and illustrations of different types of insulators made by Mr. Locke, and now we have other new designs to present.

In the accompanying illustrations Fig. 1 represents one of Mr. Locke's new insulators, designed for extremely high potential line work. Fig. 2 shows a larger size of the same device, and Fig. 3 illustrates a cross-sectional view, as will be seen from the latter illustration. This insulator is a combination of glass and porcelain, the inside part being glass and the outside porcelain. Another type is made with both parts of porcelain.

By constructing these insulators with the inner member of glass it is claimed that it is almost impossible to puncture or break down the insulation, glass offering the highest resistance against puncture and porcelain extremely high surface resistance. It is also claimed that by making insulators of two porcelain parts each part may be made thinner and more easily, thus allowing better vitrification throughout.

The two parts are screwed or fused together and are very strong mechanically as well as electrically. In several tests made on these insulators, set on steel pins, they stood 70,000 volts for four hours without heating, breaking down or arcing.

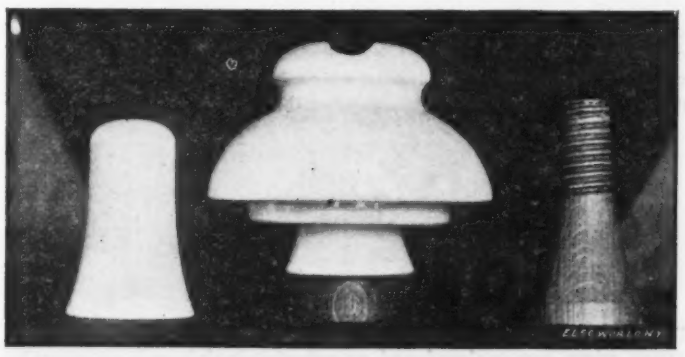


FIG. 1.—HIGH-POTENTIAL INSULATOR.

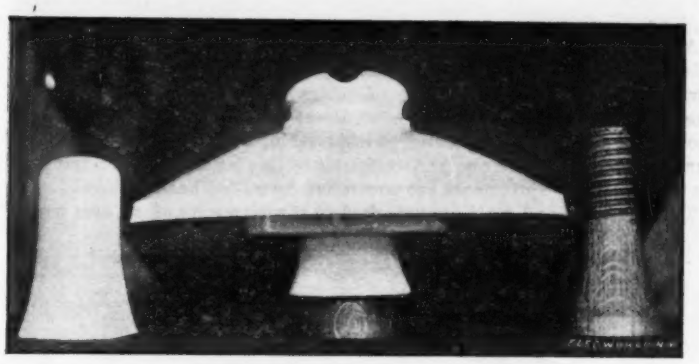


FIG. 2.—LARGE SIZE OF HIGH-POTENTIAL INSULATOR.

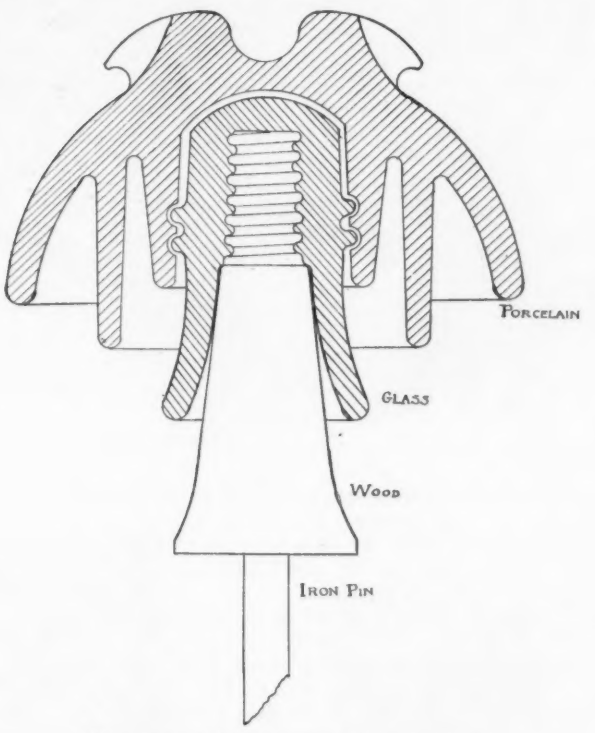


FIG. 3. CROSS-SECTION OF INSULATOR.

The insulator is designed to carry currents from 20,000 to 50,000 volts without loss.

The insulators shown in Fig. 4 are designed for currents up to 25,000 volts. The one at the left is the design used on the Niagara Falls and Buffalo transmission lines; the others are used throughout the country on circuits carrying 10,000 to 15,000 volts, all of which are said to be giving perfect satisfaction.

All of these insulators are mounted on Mr. Locke's steel pins with locust tips boiled in paraffin.

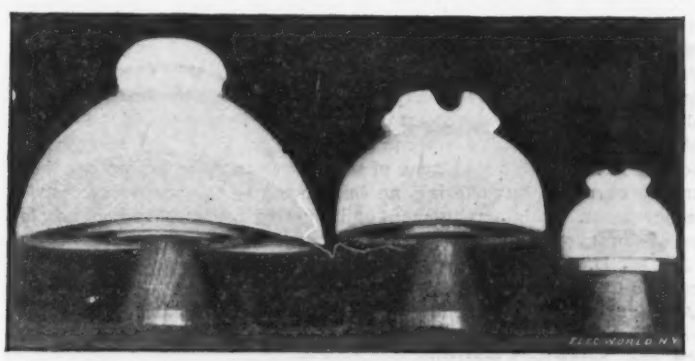


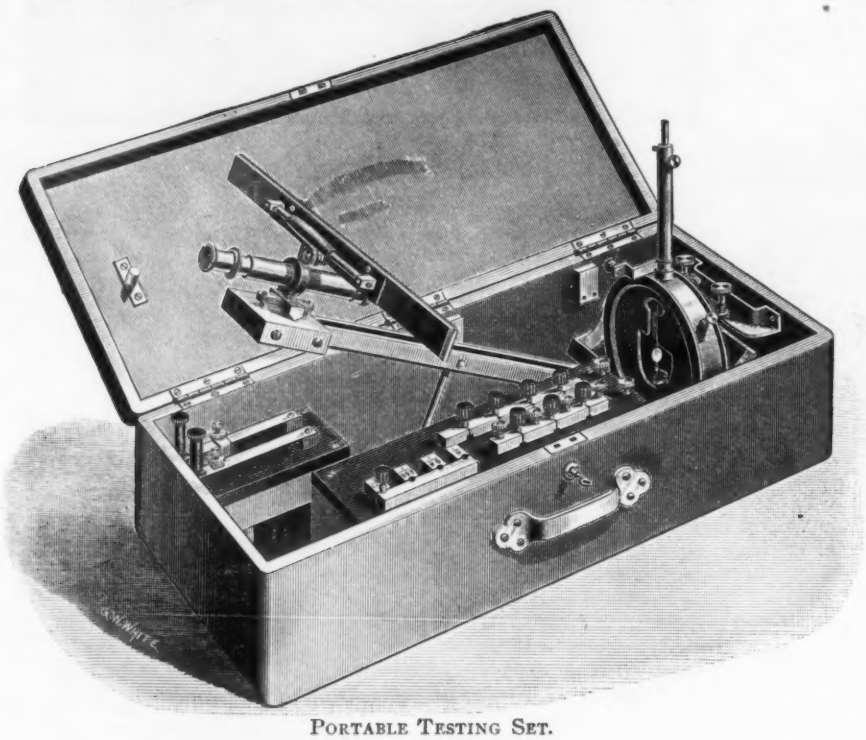
FIG. 4.—OTHER DESIGNS OF INSULATORS.

New Portable Cable Testing Set.

Messrs. Elmer G. Willyoung & Co., Philadelphia, have recently brought out a very compact and portable form of testing set for making measurements of the insulation resistance of underground and other high grade cables.

As shown by the illustration, the set is made up of galvanometer, telescope and scale, high resistance of 100,000 ohms, shunts, keys and terminals for attaching the ends of cables being tested, the method of measurement being the usual one of direct deflections. The galvanometer is swung on gimbals and is adjustable, about two axes passing through its centre, the one perpendicular to its plane, the other lying in its plane. The adjustments are controlled by milled head screws.

The telescope and scale are attached to the extremity of an arm which



Portable Testing Set.

pivots around an axis lying in the plane of the galvanometer, and passing through the centre of the mirror; this arm rests flat in the bottom of the case when not in use, while the scale slips out a kind of bayonet catch attached to the telescope casting, and is held in a pair of holders seen at the side of the box.

The shunts of this instrument are four in number, reducing the current passing through the galvanometer to $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, $\frac{1}{10000}$ of its original value. They are not placed directly across the galvanometer resistance as is usual, but across the galvanometer resistance plus an extra 100,000-ohm coil, the virtual resistance of the galvanometer circuit thus becoming over 100,000 ohms instead of only about 1500 or 2000 as would otherwise be the case.

This 100,000-ohm coil has another very important function, to understand which attention must be directed to the well-known fact that the lead sheathing of a cable is itself a conductor for "return currents." These currents are constantly varying in value and location upon the cable, as the number of motors using power varies and changes in position. These variations of flow in the sheathing produce corresponding variable currents in the core of the cable. Hence, when a steady current is sent from core through the insulation to ground, as it is in the direct deflection method of measurement, when variable currents superpose themselves upon the steady current and cause the motion of the galvanometer needle to be so erratic as to completely mask the steady deflection obtained. To overcome this difficulty the 100,000-ohm coil above is wound with a maximum of self-induction, thus wiping out these variable currents, but offering no impedance to the steady current of measurement. This arrangement of inductive 100,000-ohm coil, as also that of shunts outside of coil and galvanometer in series, is the invention of Mr. W. D. Gharky, assistant superintendent of lines and cables Union Traction Company, Philadelphia.

All parts of the instrument possess the highest insulation, all metals and all conductors being mounted upon hard rubber, the galvanometer, coils, etc., being both moisture and dust proof.

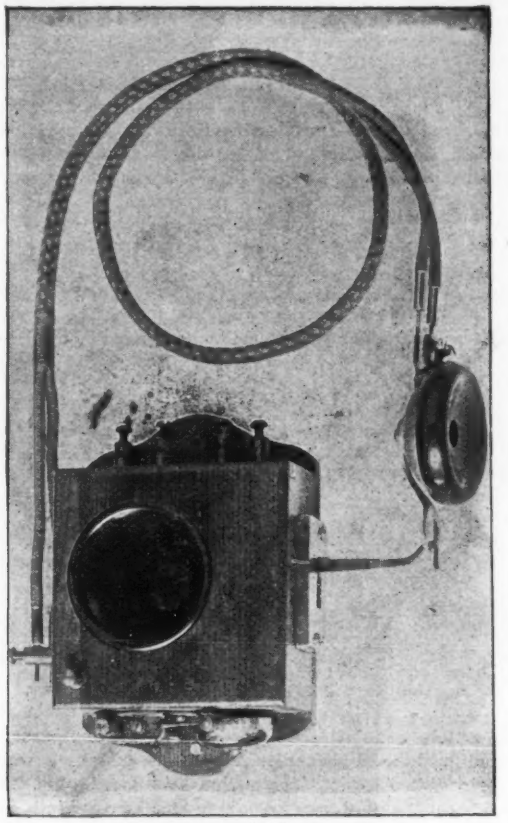
The galvanometer is of the D'Arsonval type. The first of these instruments was made for the Union Traction Company, Philadelphia, Pa., about six months ago, and has been in continuous daily use ever since.

The set should be of great value to engineers and electricians in charge of underground construction, as it enables measurements to be made during the progress of the work, and any defects due to injury in "drawing in," etc., instantly located before the mischief has had time to develop and do perhaps irreparable damage.

The apparatus is for sale by Mr. James G. Biddle, Drexel Building, Philadelphia, sole agent for Willyoung instruments.

New Telephone.

The illustration herewith represents the new interior "Pefection" telephone, manufactured by the Electrical Supply & Telephone Company, 1429 Chestnut Street, Philadelphia. It is claimed that this apparatus, although cheap, has all the merits of a high-priced instrument, and will render the most satisfactory kind of service in buildings and for short outside distances, where a metallic circuit is employed. The transmitter is different from all others on the market, is said to require no adjusting, to be always in perfect order and to be very sensitive, conveying the voice in a clear tone, without the harsh grating sound produced by some transmitters. This telephone is provided with a battery, and has a miniature bell and a push button which gives a signal at each end of the circuit.



"Perfection" Telephone.

These instruments are manufactured in both desk and wall styles. The demand for them is so great that they can, we are informed, only be secured on time orders.

"H. W. J." Electric Car Heaters.

Last Winter the H. W. Johns Manufacturing Company, New York, equipped a number of cars with its "H. W. J." heater, and the success attained by its method of heating at that time justified the company in anticipating a large business this Winter. The demand for the heaters has, it is reported, been as large as predicted. The company's experience suggested some improvements which have been embodied in the heaters illustrated herewith, representing the panel and upright forms.

Panel Heater.

The panel heater consists of a woven mat of asbestos in which the resistance wires are enclosed and an asbestos back board or support to which the mat is cemented by an insulating and water-proofing compound. The heater thus formed is thoroughly impregnated with an insulating varnish and baked in an oven, so as to render it impervious to moisture and form a practically air-tight covering for the wires. Various advantages are obtained by thus constructing the heater. The radiating and effective heating surface of the wire itself is greatly increased on ac-

count of the larger surface exposed; the wires, if necessary, can be operated at a comparatively high temperature without being injuriously affected by what would otherwise be a direct contact with the air; vibration and crystallization are obviated by the manner in which the wires are separated within an asbestos covering; a comparatively small-sized

UPRIGHT HEATER.

wire can be utilized, if desired, to obtain a high resistance without the dangers of short circuiting and breaking, incident to the use of fine wires in the form of coils.

The heater is enclosed in an ornamental steel casing and the size which has been generally adopted is 50 inches long, 9 inches wide and 7/8 inch thick, and weighs approximately 16 pounds.

The upright heater is enclosed in a cast iron casing, designed as illustrated, and is 18 inches long, 10½ inches high and weighs 17 pounds.

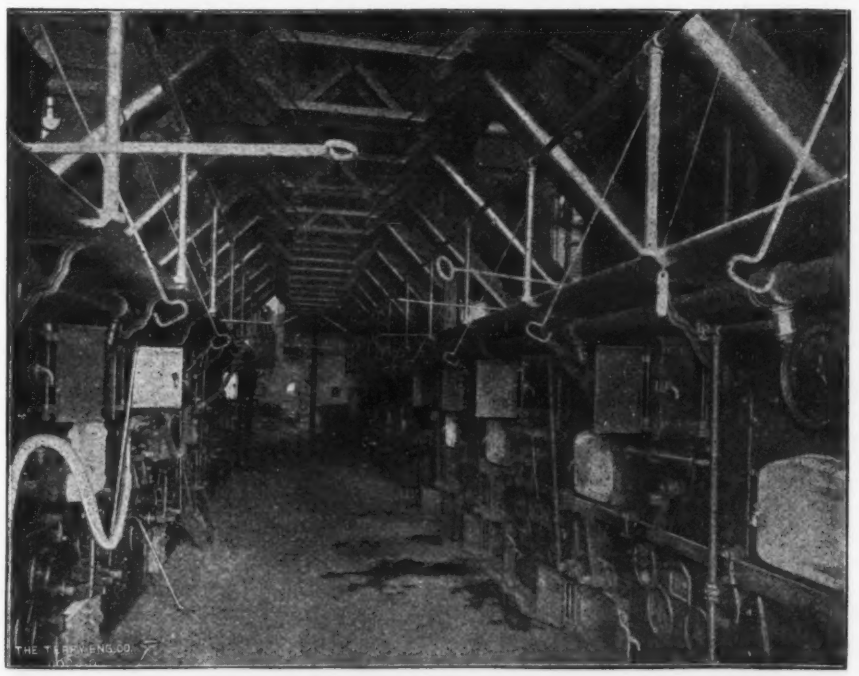
The resistance wires in the heaters are divided into two sections. The method of regulating consists in throwing the upper sections in all the heaters into series in the first combination of the switch. For an extra degree of heat the upper sections of all the heaters are eliminated and the lower sections are connected together. In the third position of the switch, which furnishes the highest temperature, the upper and lower sections are connected in parallel.

The switch is of the knife-blade pattern so as to secure a quick and positive break. Regulation is effected by the knife blade closing the circuit through terminals situated on a movable disc to which the wires from the heaters are attached.

Coal and Ash-Handling Plant.

A model plant for the handling of coal and ashes has been recently installed in the power station of the Cicero & Proviso Street Railway Company, Chicago, Ill. The system is that of the Jeffrey Manufacturing Company, Columbus, O., and a brief description of the same will be of general interest.

In the accompanying illustration is shown the boiler fronts with the overhead coal-storage bunkers, from which the coal is fed onto the stokers. Wagons deliver the coal, either slack or in lumps, to chutes ter-



COAL AND ASH-HANDLING PLANT.

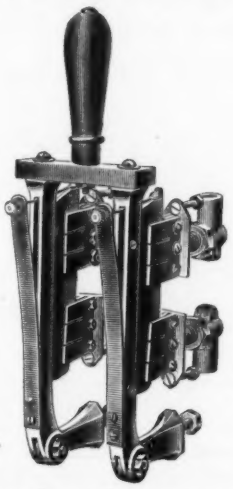
minating over a double-strand flight conveyor, which carries the coal to a tooth crusher, where it is crushed to sizes. From this it is spouted to a bucket elevator, which raises and delivers it to one of two spouts. One of these spouts terminates over the upper troughs of the initial conveyor, which carries the coal to the storage bin, the other spout terminating over the cross-angle conveyor. This angle conveyor delivers the coal to a longitudinal conveyor over the coal bunkers, gates being provided in the trough at suitable points to facilitate filling the bunkers. From the latter coal is spouted to the mechanical stokers, as shown in the illustration.

The ash-handling outfit is located in the basement, and consists of two 12-inch cast-iron spiral conveyors. These conveyors receive the ashes directly from the grate bins under the boilers and deliver them to the cross-conveyor. From this they are taken by a continuous bucket elevator and spouted to an ash-receiving tank on the outside of the building.

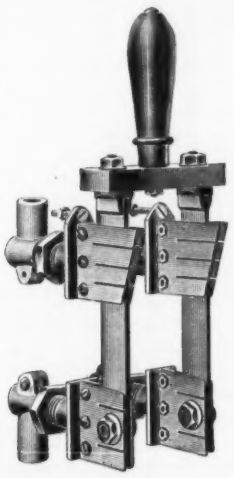
Each part of the system is independently controlled by friction clutches, the power for the plant being furnished by an automatic engine.

Knife Switch.

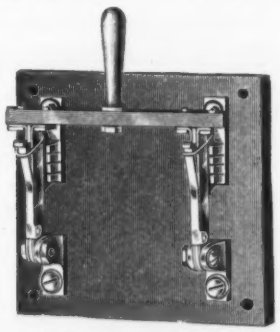
The demand for high-grade knife switches has brought upon the market designs of various makers, the most recent being those known as type "E" and type "Q," manufactured by the Western Electric Company, Chicago. The contacts of these switches are all rolled tempered copper, and the greatest care in construction and design has been observed, in order that the switches would carry their rated capacity without heating. In placing and fastening the jaws in position they are not soldered, but bolted to the metal plates or lugs, as can be seen from the illustration.



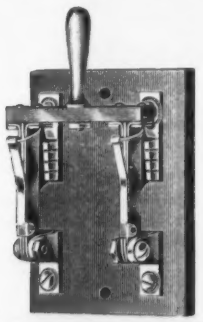
TYPE Q FOR SWITCHBOARD.



TYPE E FOR SWITCHBOARD.



TYPE Q SWITCH FOR 500 VOLTS.



TYPE Q SWITCH FOR 110 VOLTS.

By this method the temper of the jaw is in no way injured, and the jaws will grasp the blade of the switch with an equal and unvarying contact which, it is said, will not deteriorate with time. The hinge contact is made in the same way, and the bolt which passes through the hinge is provided with a lock nut, preventing any liability of loosening or poor

contact at this point. The blades are of drawn copper, hand finished. The base is extended for connections on the back of the board, and is secured in place by a lock nut. Swivel connections are provided, which will admit of the circuit wires being brought into the switch from any direction.

The type "E" is for station and switchboard work, being of the regular jaw pattern. The type "Q" is essentially the same as type "E," with the addition of a quick break spring, and is especially approved by the Underwriters for an entrance or service switch for motor work, constant potential arc, or incandescent lighting.

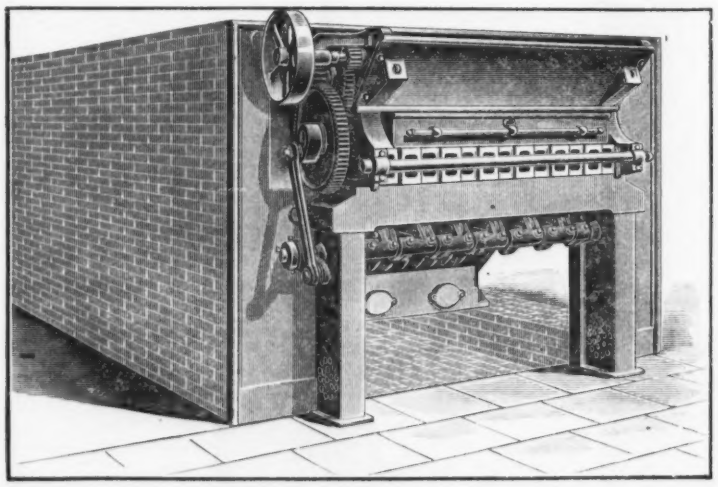
A number of sizes of these switches are carried in stock.

The Mechanical Stoker.

The nearest approach to perfection in boiler firing is attained by the use of mechanical stokers. By means of such apparatus not only is the greatest amount of heat derived from the coal, but on account of the necessarily slow feeding of fresh coal to the fire, the volatile components of the coal are practically entirely consumed by the intense furnace heat, thereby utilizing the heat of the incandescent gases where it will do most good, and at the same time avoiding waste in the form of smoke. Mechanical stokers, therefore, are at once smoke consumers and economizers of fuel.

The Wilkinson mechanical stoker, made by the Wilkinson Manufacturing Company, Bridgeport, Pa., it is claimed stands unrivaled in its development, in its applied principles and its economy of fuel. All that part of the boiler front above the bottom line of the boiler, with the grate bars, bearer bars, etc., as in ordinary practice, is eliminated in first cost, when new installations are considered or discarded when the addition of the stoker to a boiler in use are considered. In place of these the stoker front is furnished, and at either side of the furnace are placed guides extending diagonally the whole length of the grate. Suitable projections or columns and saddles support the grate bars, and the mechanism for operating them admits of securing the coal hopper and blast pipe in a very substantial manner.

The grate bars consist of a series of hollow castings placed side by side, and inclined toward the bottom of the furnace at an angle suited to the repose of the fuel. The upper end, which is open to admit the blast pipe, projects through and is supported by the stoker front, the lower end sliding on and supported by the bearer-bar. Throughout the inclined length, and on the face of the bar, is cast a succession of steps, and through the rise of each step a vent of ample proportion is provided to admit air through the fire to the combustion chamber. The continuous back-and-forth motion of the grate-bar insures a uniform thickness of fire, an ample supply of air for any rate of combustion, an absence of clinker and a slow but gradual advance of the remaining fuel to the bottom of



Mechanical Stoker.

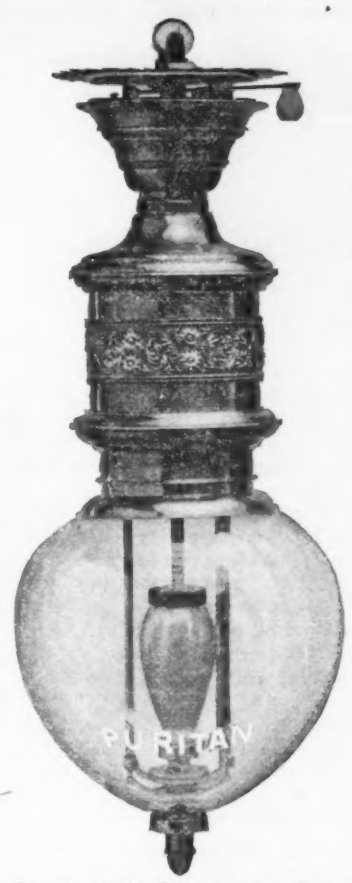
the grate after it has been thoroughly consumed and is in the form of ash free from carbon. The accumulated ash is pushed off the stationary grate by the reciprocating motion of the bars into the ash pit. The mechanism for effecting the entire operation of the stoker consists of a pulley, compound gearing, toggle shaft and quadrant, and the power required is said to be nominal. The blast is situated so as to project through a nozzle having one sixteenth of an inch opening, which gives an induced current of air of wide range and is under complete control by a regulating valve.

The illustration represents a front view of the Wilkinson stoker of the 1896 model, showing very clearly the operative details.

These stokers are used in a large number of electric railway power houses throughout the country, and in many cases second orders for the apparatus have been given and filled.

Alternating-Current Arc Lamp.

A new 100-hour alternating-current arc lamp is that recently put on the market by the Puritan Electric Company, 150 Nassau Street, New York City. The lamp is designed to fill the same place in an alternating-current circuit that the enclosed arc already occupies on direct-current circuits.



Alternating-Current Arc Lamp.

The mechanism is extremely simple and not at all liable to need repair or readjustment. The illustration shown herewith represents the lamp all ready for service. The globe may be easily lowered and is not liable to be broken. Two 7½ by ½ inch cored carbons are used, giving a steady and uniformly distributed light. The lamp can be used on circuits of from 7000 to 16,000 alternations, and voltages of from 100 to 120 volts. It is 33 inches in length and of an artistic form doing away with the chimney effect common in most lamps.

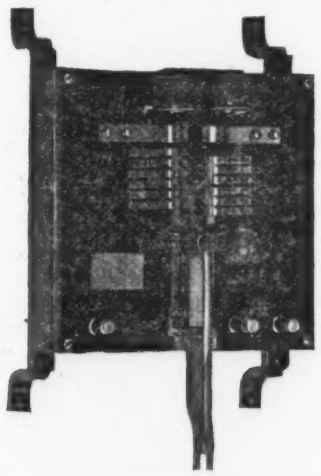
The same lamp by a slight adjustment of the resistance will burn upon continuous-current, constant-potential circuits without change of mechanism, and is being perfected for regular series arc circuits of 6.8 and 9.6 amperes, so that it is, in fact, a "universal" lamp.

The great feature claimed for this lamp for alternating work is that it is noiseless, a point which should ensure its cordial reception.

Although this lamp has been but recently introduced, the Puritan Electric Company states that, with its unparalleled facilities, it is prepared to fill all orders promptly.

Multiple Rheostat.

The Frank Ridlon Company, 180 Summer Street, Boston, Mass., is manufacturing a new form of rheostat, which after a thorough examination by experts is pronounced as being constructed on most satisfactory and effective principles. The patents were granted April 14, 1896. The



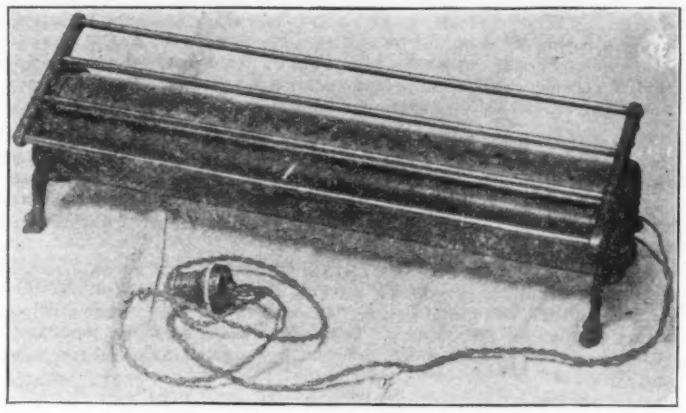
Multiple Rheostat.

rheostat, an illustration of which appears herewith, may be briefly described as follows: The resistance is thrown in multiple into the circuit, each resistance rod being of such resistance as to allow only a certain amount of current to pass through it, these rods being thrown in one after the other until the whole amount of the current passes through the rheostat; it is then short-circuited through low resistance copper strips. Each resistance rod does not only its share of the work, no matter how much current is passing through the rheostat, since by throwing in resistances in multiple the carrying capacity is increased as the resistance is decreased. A specially prepared solid composition graphite rod is used as the resisting medium. These rods are tested at a very high heat. They are said to be practically indestructible from this cause, and it is claimed to be absolutely impossible to burn them out or destroy them, when used in connection with the work for which they were

designed. If by accident one of the resistance rods becomes injured from any cause the rheostat can still be used, as it is impossible to cause an open circut. These rheostats are built to fully cover all insurance requirements. The Frank Ridlon Company is now prepared to fill orders for motor-starting rheostats, with or without the automatic release motor speed regulators, theatre lamp dimmers and dynamo field rheostats.

Combination Electric Heater, Foot-Warmer and Rest.

This device, which is being introduced by the Globe Electric Heating Company, Philadelphia, is in every way novel and practical. The heater is made up in a very neat design, with Russia iron, nickel and black finish, being 20 inches long and stands 6 inches high. The heating coil, which is run at such a high temperature for general heating purposes, is



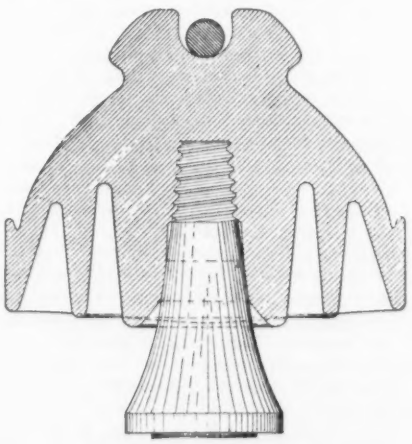
COMBINATION ELECTRIC HEATER AND FOOT WARMER.

protected by steel rods for a foot rest, which rods are at such a distance as to give the proper temperature for the feet.

This heater, the company states, consumes one-half an ampere on 110 volts. No extravagant claims are made for the electric heaters manufactured by the Globe Electric Heating Company. The company guarantees that its heaters are all that is claimed for them. They find great favor in all branches of electric heating.

Porcelain Insulators.

The insulation of the Niagara power transmission line between Niagara Falls and Buffalo was a problem that called for the exercise of technical knowledge and skill of the highest order. The extremely high voltage necessitated the use of insulators of special design and construction to withstand the enormous strain. The right insulator was found in the one illustrated herewith, which is known as the "Niagara type." These insulators were designed by the builders of the transmission line, the White-Crosby Company, New York, and made by the Imperial Porcelain Works, Trenton, N. J., which concern enjoys an excellent reputation in the electrical trades for the quality of its porcelain insulators and other electrical appliances made of the same material.



PORCELAIN INSULATOR.

The Niagara type of insulator has, it is stated, proved to be the only one that has met the extraordinary requirements of the Niagara-Buffalo transmission line. The insulators are subjected to a test of 40,000 volts' pressure, although 10,000 volts is the regular working pressure. This high test is for the purpose of securing a large factor of safety, and all insulators that show any sign of weakness are thrown aside. These insulators weigh about 10 pounds each, and are 5½ inches high. They are, we are informed, used exclusively on the Niagara-Buffalo line and doing excellent work.

Porcelain for everything in the electrical line is made at the Imperial Porcelain Works, of which Mr. Frederic A. Duggan is proprietor. The well-known "Duggan" one, two and three-wire porcelain cleats are made here, and special attention is given to complicated work of original design. With the facilities available the Imperial Works claim to be equal to any demand that can be made upon them.

Improvements in the J. G. Brill Company's Street Car Manufacturing Plant.

During the past season the J. G. Brill Company, Philadelphia, Pa., has made extensive repairs, enlargements and alterations to its works with a view to a great increase of business in the immediate future. The total cost of these improvements up to Jan. 1, 1897, was a little more than $40,000. The erecting shop was enlarged by an extension and a 40-foot electric transfer table was built. The blacksmith shop has been provided with a new underground coal vault. The truck shop has been enlarged, and the blacksmith shop is 56 feet by 50 feet larger than it was formerly, the extra space being necessary for the accommodation of new tools and a new reverberating furnace. Eight acres of ground have been brought within the enclosure, the entire plant now covering an area of a little more than 18 acres.

Numerous new tools and appliances have been placed, among them being a new three-ton hydraulic lift in the cabinet shop.

The machinery in the blacksmith shop and machine shop is driven by a new 75-hp Ideal engine, thus relieving the main engine of that much load. In the power house a 500-volt generator has been added and other changes in the electric plant and system made. The power for the operation of the two electric locomotives, the transfer tables and various other machines is supplied by the same generator, and by means of the same current all electric cars are tested by running them with their own motors before they are turned out of the shops.

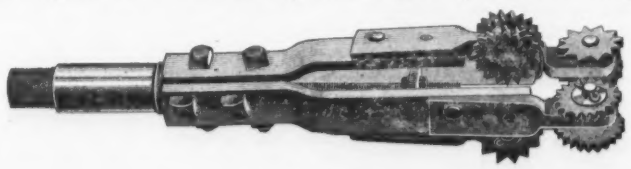
Third Avenue Railway Extension.

A contract for the equipment of the Spuyten Duyvil extension of the Third Avenue Railway Company, New York City, has been signed by the railway company and the General Electric Company. The road will be operated by the overhead trolley between the junction of the Kingsbridge Road and Amsterdam Avenue at 165th Street, *via* Kingsbridge Road to Spuyten Duyvil Creek, about two and a half miles. The poles will be of ornamental cast iron placed in the middle of the roadway, and each alternate pole will carry a 2000-cp arc lamp.

The power-house will be situated on the banks of Spuyten Duyvil Creek at 214th Street. It is stated that 15 water-tube boilers aggregating 2500 horse-power will be installed together with three engines of 1100, 700 and 500 horse-power respectively. The generators will be direct-connected, the current being partly distributed through subways alongside the line. The rails will be copper bonded, while a return feeder will also be placed between the rails of each track. Two 125-light Brush arc machines will supply the arc lights along the line. It is expected that the line will be in operation by next Summer. It is estimated that the cost of the power-house alone will be $100,000, while that of the electrical equipment will be about $250,000.

Tube Cleaner.

Weinland's tube cleaner, illustrated herewith, is the invention of an experienced practical engineer, and it is now being manufactured by the Lagonda Manufacturing Company, Springfield, O. This device has four steel springs secured to a short shaft; steel clips or arms are riveted to the springs, and hard iron sharp-toothed wheels are mounted upon the ends of the clips. The mechanical details have been carefully worked out and means are provided for adjusting the diameter of the cleaner. The wheels fit closely in the tube and cut the scale so that it can easily be flushed out without water. The wearing parts of the cleaner are composed of the best tempered steel and hardened iron, and are very durable. The cleaner has been thoroughly tested by various engineers, and it is said has already been adopted by some of the largest



TUBE CLEANER.

manufacturers of tubular boilers. The Lagonda Company can supply these cleaners for 2½, 3½ and 4 inch tubes, and will undertake to furnish any special size desired. The company guarantees that the worst case of scale can be removed by this cleaner, and the tubes can be kept clean at a very low cost.

1896 THE BUSINESS WORLD 1897

THE BRADFORD BELTING COMPANY, Cincinnati, O., is making large and widely distributed shipments of the Monarch insulating paint for use on armatures, switchboards, conduits and wherever a paint with high insulating qualities is required.

THE TAYLOR ENGINE COMPANY, Chambersburg, Pa., is receiving encouraging reports of the performance of its engines employed in dynamo service, both belted and direct connected. These engines have attained an excellent record for economy, regulation and durability.

THE CLONBROCK STEAM BOILER COMPANY, Brooklyn, N. Y., has secured the entire boiler contract for the Tennessee Centennial Exposition, to be held in May next. This is quite a triumph for the Morrin Climax boiler, considering the merits of the boilers offered in competition.

THE WILKINSON MANUFACTURING COMPANY, Bridgeport, Pa., is pushing the sales of the Wilkinson Stoker. This device is particularly adapted for the burning of the cheaper or low grades of coal. A considerable number of these stokers are in use and are said to be giving complete satisfaction.

HUEBEL & MANGER, Brooklyn, N. Y., have enjoyed an increasing business for several months past, and their factory is now running at its full capacity to keep up with the rush of orders coming in daily. Their style "H" iron box bells have become exceedingly popular, and are selling in large quantities.

THE W. S. HILL ELECTRIC COMPANY, New Bedford, Mass., is busy filling orders for its various switches, switchboards and other electrical appliances. This company's goods have become familiar to the buyers in the electrical trade and its well-known merits are the cause of the constantly increasing sales.

THE BEACON LAMP COMPANY announces that its new factory at New Brunswick, N. J., has been running until 10 o'clock every night lately in order to keep paee with the demand for its product. The factory is thoroughly supplied with every facility for the rapid manufacture of incandescent lamps of the highest merit.

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., has issued a neat price list of its various styles of field and starting rheostats. This company's product is simple and substantial in construction; large sales are anticipated in the near future. Messrs. Kohler Brothers, Monadnock Block, are the Chicago agents.

THE AMERICAN CARBON COMPANY, Noblesville, Ind., reports a very satisfactory volume of business during 1896, which it anticipates will be largely increased during the coming year. The company's factory is equipped with all the necessary machinery and other facilities for turning out large quantities of high grade product.

THE NORTHWESTERN TELEPHONE & ELECTRIC COMPANY, Milwaukee, Wis., has installed a number of exchanges in the larger cities of Wisconsin and is prepared for a heavy business in 1897. The company is ready to receive short time orders for switchboards, transmitters, magneto bells and all other telephone appliances.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., has been doing a good business in its well-known porcelain specialties for electrical purposes. Laclede carbon batteries are also manufactured by this company, which has excellent facilities for turning out large quantities of high grade goods at short notice.

THE WILLARD ELECTRIC & BATTERY COMPANY, 49 Wood Street, Cleveland, O., announces that it is prepared to construct and install storage batteries of any size with complete guarantees as to life and efficiency. The company also offers to give purchasers a guarantee protecting them from any infringement suits which may be instituted.

MR. CHAS. M. JARVIS, president of the Berlin Iron Bridge Company, East Berlin, Conn., says he is decidedly of the opinion that this country is entering on a period of prosperity such as has never before been known. Not an era of high prices, but of general prosperity, when there will be work for the idle, employment for capital and fair returns for us all.

THE PACIFIC ELECTRIC COMPANY, La Crosse, Wis., makes a specialty of shade lamps for physicians, dentists, students and others who desire to concentrate the light rays upon their work and at the same time provide protection for their eyes. These lamps are adjustable and are made in 10 different styles. Catalogues will be mailed upon application.

THE O. C. WHITE COMPANY, Worcester, Mass., anticipates a large and widely distributed business during 1897 in its incandescent lamp supporters. These supporters are equally suitable for office, residence or workshop use and in fact are adapted for use in any place where it is desired to regulate the height or vary the position of an incandescent lamp.

THE PHILADELPHIA ELECTRICAL & MANUFACTURING COMPANY, Twentieth and Jones Streets, Philadelphia, is meeting with very gratifying success in the sale of its improved clutches for T.-H. and Brush arc lamps. The merits of these clutches are becoming recognized throughout the trade and the demand for them is constantly increasing.

THE CENTRAL ELECTRIC & FOUNDRY COMPANY, 27 Thames Street, New York, calls attention to its line of electric hoists, many of which are now in use and giving admirable service. The direct-connected generators and slow-speed dynamos and motors manufactured by this company are also rapidly making friends among the users of electrical machinery.

THE ELECTRO-CHEMICAL STORAGE BATTERY COMPANY, 34 Broad Street, New York, calls attention to its storage batteries for horseless carriages, advertising and delivery vans, etc. This company's batteries are used extensively in central station lighting and railroad work, house lighting, telephone and telegraph service, etc., and they are giving entire satisfaction.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, reports a fine business during the month of December. The sales on the N. I. R. wire have been specially good, a number of large orders being received. The company reports a considerable increase in the volume of business over the month of November, and looks for a continued improvement during the new year.

THE CHAPIN-DOUGLAS ELECTRIC COMPANY, 136 Liberty Street, New York, reports that it has sold large quantities of Burnley's soldering paste. This article fills a large demand and has proven excellently adapted to its purpose, which accounts for its great popularity throughout the trade. The prospects for continued increase in the sale of this paste during 1897 are very bright.

THE GOUBERT MANUFACTURING COMPANY, 14 Church Street, New York, is still making gratifying sales of the Stratton separators. Large numbers of these devices are giving satisfactory service in numerous steam plants throughout the country. The company will furnish a book entitled "Dry Steam" to any one who is sufficiently interested in the subject to write and ask for it.

THE KENT ELECTRIC MANUFACTURING COMPANY, 25 Hermon Street, Worcester, Mass., is meeting with gratifying success with its alternating-current sewing-machine motor. It is simple and convenient, and the regulation is said to be perfect. There is a large field for a reliable motor of this class, and the Kent Company will undoubtedly meet with large sales during the coming year.

MR. I. P. FRINK, 551 Pearl Street, New York, has been very successful in disposing of Frink's special window reflector, which has been adopted by a number of the leading stores throughout the country. The reflector is mounted near the glass at the top of the window and reflects the light inward and downward, thus illuminating the displayed articles in an exceedingly satisfactory manner.

QUEEN & CO., INCORPORATED, 1010 Chestnut street, Philadelphia, are carrying a full line of Röntgen-ray apparatus in addition to their well-known and extensive list of galvanometers, ammeters, voltmeters and electrical measuring and testing instruments of all kinds. The reputation of this company's product is of the best, and the outlook for a large increase in sales during 1897 is most favorable.

THE CARD ELECTRIC COMPANY, Mansfield, O., is manufacturing the Card automatic safety and limit switches in large numbers. These switches are particularly adapted for use with stationary motors and they are making many new friends. They meet all the requirements of insurance companies, and have their approval. The Card company will be pleased to forward a descriptive circular upon application.

THE KNEELAND REFLECTOR COMPANY, 24 Travers Street, Boston, Mass., manufacturers of the McCreary silvered reflector shades for incandescent electric lights, is doing a good business. The company, besides manufacturing its silvered shades, is putting on the market a green shade to meet an increasing demand. Mr. Kneeland, of this company, expects during the year 1897 to largely augment the company's growing business.

THE PARAGON ARC LAMP COMPANY, Devonshire Building, 16 State Street, Boston, states that all indications promise a prosperous year for that company. The demand for its complete line of arc lamps for all circuits, including the long-burning lamp for constant potential circuits, are beyond its most sanguine expectations, and it feels that its confidence in the high merit of its lamps is obtaining rapidly with the electrical trade.

THE C & C ELECTRIC COMPANY, 143 Liberty Street, New York, is making numerous sales of its direct-connected motors for elevator work, printing press driving and similar purposes. The company's factory at Garwood, N. J., also continues to turn out large numbers of the multipolar belt-driven motors and generators. The excellent equipment in the factory enables the company to fill orders with great promptness and satisfaction.

THE AUTOMATIC CIRCUIT-BREAKER COMPANY, Newaygo, Mich., reports that business is on the increase and that the prospects for the coming year are very encouraging. Well it ought, as it manufactures a superior line of automatic circuit-breakers, and as it has that faith in its instruments that it is willing to send them out to good, responsible parties subject to 30 days' approval; prospective purchasers therefore are taking no chances whatever.

MESSRS. PASS & SEYMOUR, Syracuse, N. Y., are looking forward to a largely increased business during 1897. Notwithstanding the hard times they have enjoyed a very satisfactory business during the past year in their well-known key and keyless sockets, wall sockets and other specialties. The reputation of this firm's products for durability and reliability is well established throughout the electrical trade. A descriptive catalogue will be mailed to any one who applies.

MESSRS. EYANSON & ARMPRIESTER, 123 North Third Street, Philadelphia, are receiving gratifying reports of the performance of their switches, switchboards, etc. They are exceedingly particular regarding the electrical

and mechanical details of construction of all their product, and the results justify the additional care and expense. The firm is represented in Chicago by the Metropolitan Electric Company, and in New York by Messrs. Chapin & Douglas, 136 Liberty Street.

MESSRS. MORSE, WILLIAMS & CO., Philadelphia, Pa., are maintaining their well-known reputation for the excellence of their elevators, both electric and hydraulic. They build both passenger and freight elevators and are always up to date on the latest improvements in mechanical and electrical details. Their factory is completely equipped with every modern machine tool and other device found necessary in order to turn out apparatus of the best quality at short notice.

THE EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT (General Electric Company), Harrison, N. J., has had a special rush during the last few months in the manufacture of special electrically illuminated signs and decorations, as well as in decorative and candelabra lamps. Electric sign work has grown very considerably of late and promises well for the future. The Röntgen-ray apparatus furnished by the department is also reported as giving most excellent results.

MR. CHARLES T. ALLEN, secretary of the Union Steam Pump Company, Battle Creek, Mich., reports that although conservatism and curtailment of output appears to be the general feeling, its business for 1896 was nearly three times that of 1895, and present indications, considering the times, leads him to believe its 1897 work will be double that of 1896. Its business is very slow speed engines, 15 to 20 revolutions per minute, and steam pumps. It has a capacity of 300 pumps per month.

MR. JAMES JONES, JR., of J. Jones & Son, 67 Cortlandt Street, New York says: Our business never had brighter prospects than at the present writing. Though times have been dull during the last three years, we have made increasing sales. With business in general picking up after the long depression, I can see no reason why the electrical and kindred trades should not develop flourishing proportions once more. Everything points toward a Happy New Year in a business way.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, O., is opening the new year with the announcement of a new 100 to 150-hour enclosed arc lamp for series circuits. The lamp operates with 450 watts, six amperes at 75 volts; no rheostat is required, and hence there is no loss of energy. All the details of the new lamp have been carefully worked out, and the lamp will undoubtedly meet with success and add to the reputation which the company already has for the general excellence of its product.

THE BERNSTEIN ELECTRIC COMPANY, Boston, Mass., is exceedingly busy. It has recently increased its capacity but is nevertheless unable to keep pace with the orders. The business outlook for 1897 is very good, and the company anticipates a solid increase over and above previous years. Its new catalogue of fixtures for street series lighting will be out in a few days. With improved business conditions generally, the electrical business in particular should improve during the new year.

THE MURRAY IRON WORKS COMPANY, Burlington, Ia., now in the 28th year of its corporate existence, is making extensive improvements to its foundry, machine shop and boiler works. These additions are necessary to enable it to take care of its rapidly increasing business. This concern manufactures Corliss and throttling engines in all styles and sizes, hoisting engines and the best grade of tubular boilers, and even during the dull year just ended its plant has been driven to its full capacity.

THE LINK-BELT ENGINEERING COMPANY, Nicetown, Philadelphia, has attained an enviable reputation for the excellence of the design and construction of the various labor-saving appliances for power houses which it manufactures. It has installed complete coal and ash handling apparatus in a number of the largest electric lighting and power plants in the country. The company also manufactures elevators, conveyors, driving machinery, etc. The New York office is at 49 Dey Street.

THE EDDY ELECTRIC MANUFACTURING COMPANY, Windsor, Conn.—Abundant evidence is manifest that this well-known company should feel proud of its record during 1896. Its sales and business have increased wonderfully, and the merits and popularity of its electrical apparatus have won enviable victories in notable installations and widely extended adoption—a record which its wide-awake executives and highly efficient corps of agents will in 1897 surpass easily without any question.

THE D'ESTE & SEELEY COMPANY, 29 Haverhill Street, Boston, Mass., is meeting with gratifying success in the sale of steam, water and air-pressure regulators, steam traps, steam separators, etc. The Curtis regulators have attained an excellent reputation for accuracy and reliability. The steam traps and separators have been adopted in a large number of important plants, and the duplicate orders received by the company are the best obtainable evidence of the satisfactory service given by these devices.

THE GIBBS ELECTRIC MANUFACTURING COMPANY, Hartford, Conn., states: It is a matter of considerable congratulation with us that we have received and are still receiving from the electrical trade good and liberal orders for our new line of switches, double-pole, single-pole and flush, three and four way, and we attribute it wholly to the well-known representation of our Mr. J. S. Gibbs in switch manufacture, and also to the fact that his very best work is now manifest. We expect a good year in 1897.

THE CARBORUNDUM COMPANY, Niagara Falls, N. Y., although a comparative newcomer in the electrical field, is a rapidly expanding concern, and its products serve a very important purpose in the industrial world. For grinding and cutting tools nothing equals carborundum. The year 1897 promises to be a very important one for this company, and with an abundance of power nearby and with the proposed extensions of plant, the products of the company may be turned out in an almost unlimited amount.

THE CENTRAL CITY BRASS COMPANY, Syracuse, N. Y., reports that the Moss self-centering carbon holder is meeting with continued success, and that those interested would do well to investigate the merits of this holder. It adds that lamp trimmers are loud in their praises of the holder, as they can accomplish their work easier and better with it than with other holders; with this holder the lamps are not extinguished by the flashing of the machine. It is automatically self-centering and can be fitted to almost any lamp.

MR. E. A. WARREN, manager Webster Chemical Company, St. Paul, Minn., states: The sale of our crystal chemical coloring for incandescent lamps was very satisfactory during 1896, but we look for a considerably larger volume of business in 1897. Our chemical coloring is a solution into which the lamps are dipped, thus coloring them at a cost of only about 1 cent each. This is now acknowledged to be the standard preparation of its kind, and has been sold throughout every State in the Union, as well as in 11 foreign countries.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., continues to ship large quantities of its goods to various parts of this and other countries. This company has had 25 years' experience in manufacturing electrical instruments and appliances, during which time it has always been ready to adopt any change which would result in improving the product and the merits of the magneto bells, telephones, district telegraph call boxes, etc., manufactured by the Viaduct company, which are too well known to require enumeration.

MR. AUGUST BECKER, 55 Oliver Street, Boston, is more than satisfied with the business recognition accorded him in 1896. Mr. Becker feels confident of a much larger business in 1897. Expert in the designing and engraving of name plate castings in steel, brass and other metals, having made it a special study for over 15 years, Mr. Becker has created an enviable demand in this special line, and his customers now include the larger as well as the smaller manufacturers of electrical engines and special machinery, and the best representatives in all branches of trade.

THE ZIEGLER ELECTRIC COMPANY, Boston, in addition to the manufacture of fine electrical instruments of various kinds and of physical and scientific apparatus, for which it has a high reputation, also handles a variety of electrical supplies and material. In its two illustrated catalogues (comprising together some 450 pages), is to be found much valuable and special matter in which the electrical fraternity will be interested. The year 1896 has been exceptionally prosperous for this company, and there are abundant promises for greater prosperity in 1897.

THE HINE & ROBERTSON COMPANY, 43 Cortlandt Street, New York, is receiving numerous encouraging reports from the users of the various steam appliances which it manufactures. The popularity of the company's planimeters, steam engine indicators, steam separators, etc., is still increasing and large sales will undoubtedly be made in 1897. The company's waste oil filter and the "Keller" damper regulator are also meeting with large sales. All these and many other devices are fully described in a catalogue which will be mailed to any one asking for it.

JAMES LEFFEL & CO, Springfield, O., has four of its well-known "Niagara" type turbines in successful operation in the power company's new plant at Niagara Falls; they are each of about 2200 horse-power. These turbines drive eight generators of something over 1000 horse-power each, two generators being connected directly to the shaft of each wheel, one on each side. The same company has four other Leffel turbines, using in all eight of that type of wheel. This plant is said to be the most complete and perfect water power plant in the world.

THE RELIANCE GAUGE COMPANY, Cleveland, O., reports that inquiries are much more numerous than they were before the election, and it finds it much easier to interest possible customers. The demand for the company's safety water columns, leakless gauge cocks and other specialties has not fallen off in proportion to general trade during the recent depression, and the company has every reason to believe that it will show a very large increase during the coming year. It is increasing its stock, and preparing in every way to promptly supply the increased demand.

PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, Hartford, Conn., reports that results during 1896 have been very gratifying. Old patrons have been held and new ones secured. New and important changes have been introduced in the manufacture of switches and sockets, and also in its arc lamp manufacture, an enclosed arc lamp of 150 hours burning with 12 inches of carbon being one of its most recent products. Every possible effort has been made to deserve the appreciation and increased business extended, and to secure even a stronger foothold for the new year.

MR. R. F. BLODGETT, secretary Pratt & Whitney Company, Hartford Conn., says that the business of the Pratt & Whitney Company in 1896 exceeded in volume that of any previous year of the company's existence, with one exception. A large part of the business was in bicycle machinery, and during the second half of the year mainly with European manufacturers. The increased sale of automatic weighing machines, Mr. Blodgett thinks, indicates the growing confidence of the public in its accuracy and reliability. In other lines fair sales were made during 1896, but an increase in 1897 is anticipated.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., begins the new year full of hope. The demand for its dynamos and motors, which are efficient machines, is constantly increasing, and those that are now doing duty are giving satisfaction. The company makes a strong point in its method of winding armatures. Every wire is exposed to the air, and the armature is thoroughly ventilated, thereby increasing heat radiation and at the same time rendering repairs an easy task. The Commercial machines possess several features of merit which deserve the closest attention of prospective buyers.

K. McLENNAN & CO., of Chicago, Ill., the sole manufacturres of "Gale's Commutator Compound," tell us that the sales of their compound during the past year has been more than treble that of any previous year; that wherever "Gale's" has been tried it becomes readily adopted, and that at this time more than three-fourths of the power plants and central stations have adopted it. It is now universally conceded to be a "dynamo necessity." To the isolated plants as well as the central stations and power plants who have not already tried this compound, they will continue to send upon request a free sample stick.

MR. F. S. TERRY, of the Sunbeam Lamp Manufacturing Company, Chicago, was in New York recently and he reports the outlook for 1897 as exceed-

ingly promising. The company's arrangement with the Western Electric Company, whereby that company has entire charge of the sale of Sunbeam lamps, is proving very satisfactory to all concerned. The Sunbeam Company has completely equipped a new factory at Desplaines, Ill., with the best modern machinery and appliances for manufacturing high-grade lamps; these excellent facilities will enable the company to fill all orders promptly and satisfactorily.

MR. A. E. HUTCHINS, 973 Thirteenth Street, Detroit, Mich., reports that his safety hanger for trolley wires is giving excellent satisfaction wherever used. The great advantage claimed for this hanger is that it is made in three sections; the middle part forms a recess into which the two ends which attach to the trolley wire are hooked. The parts are normally held together by the pull of the suspended wire, and if the wire becomes broken the jarring of the line releases the broken end from the hanger, and it therefore becomes "dead" and falls to the ground, thus enabling the cars to pass the break by their momentum.

GEN. ELBERT WHEELER, treasurer of the Wheeler Reflector Company, Boston, Mass., says that he has every confidence in better times coming. Congress, he argues, will certainly exert itself to improve business and financial conditions. The business world has confidence that any changes made will be for better and not worse. As for the business of the Wheeler Reflector Company in 1896, the company has largely increased its list of customers, if not the volume of trade, and is in excellent position to enlarge both during the present year. The General therefore says: Hail and welcome to 1897!

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn.—The year 1896 has been unusually active and prosperous for this company, its new productions and improvements in the line of switches commanding on their merits the extended recognition they greatly deserve. Specialists in the line of switches, the company is increasing in its efforts to meet and even anticipate the necessities of the electrical field, which fact, combined with excellence of manufacture and careful business management has earned for it its excellent reputation, and augurs continued and even greater prosperity during the year 1897.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., reports that in its experience 1896 has been a season of hard times and many moments of uncertainty, but that the spirit of self and mutual help has been alive and is now bearing fruit in the form of better business. The prospects for 1897 it considers to be good, at least to those who are hopeful and energetic; even in 1896 the company increased its business in a few special lines to which extra hard and intelligent work was applied. The company feels therefore that the conditions are favorable to all manufacturers for both home and export trade.

MR. H. C. HAWKS, president of the Anchor Electric Company, 71 Federal Street, Boston, Mass., reports that his company entered the year 1896 with the expectation that, with the hard times and business depression facing it on every side, it would be unable to make its net sales for the year equal those of the previous year. It has, however, he says, been much gratified to find that they are in excess of those of the previous year, and though there has been a smaller margin of profit, it has every reason to be satisfied with the result, and believes that the year 1897, with the prosperity which is sure to come with it, will bring us a still further increase.

THE FERNANDINA OIL & CREOSOTE WORKS, Fernandina, Fla, reports that it has just received an order from the Southern Bell Telephone Company for about 4000 creosoted yellow pine poles. Since 1888 every effort has been made by this company to induce the telegraph and telephone companies to use creosoted poles, and during the past year it has received some orders for poles ranging in lengths from 45 to 90 feet, and measuring from 8 to 10 inches in diameter at the top. The Fernandina Company believes that the large telegraph and telephone companies are now becoming convinced that the use of creosoted poles is decidedly to their advantage.

MR. F. D. LESLIE, manager Institute of Home Study of Engineering, Cleveland, O., states that engineering knowledge is much needed to-day by thousands of bright men who could greatly increase their earnings were they better informed. This institute enables such men to obtain an education without giving up their positions. We are not, he says, in competition with regular schools, but extend opportunities to those whom the schools do not reach. We can teach mathematics, mechanical and electrical engineering to any man having his evenings to himself and who will work diligently. A copy of our 72-page catalogue can be had for the asking.

THE BAECHTOLD & PARKER ELECTRIC COMPANY, 79 Washington Street, Brooklyn, N. Y., is headquarters for the American-Wood arc dynamos, lamps and appliances, which it is now offering to the trade on particularly favorable terms. A full line of electrical supplies is also carried in stock and orders can be filled on short notice. A special feature is made of repairs to all kinds of electric and railway apparatus. Quite recently the company has enlarged its facilities very materially and a full force of experienced men is kept constantly at work. Mr. Baechtold says that the outlook is encouraging and that 1897 will undoubtedly be a year of large achievements.

THE O. S. PLATT MANUFACTURING COMPANY, Bridgeport, Conn., manufacturer of the celebrated New England switches, has increased its business, and is constantly making new things in the electrical line. Among the latest are its flush and indicating switches, and low priced knife switches, as well as high grade knife switches for 100 to 200 amperes, for switchboard use. All of the goods made by this firm are strictly first class, thoroughly practical, and mechanically well constructed, making them durable as well as meeting all electrical requirements. This company is also selling sockets, rosettes, cut-outs, etc., in large quantities and at best market prices.

MR. R. S. HALE, manager the Wright Demand Meter, 31 Milk Street, Boston, states as his belief that the business outlook for 1897 is decidedly favorable. Several lighting companies are planning to adopt this meter in order to base their contract rates for power on its readings. In this way a customer will be entitled to put in a large-sized motor, but will not have to pay for anything more than the smallest sized motor with which he could get along. Some of the meters have already been delivered by Mr. Hale, the first lot to the Edison Illuminating Company, Boston, and a full supply is expected shortly after Jan. 1. Several improvements have been made on the English pattern.

THE FITCHBURG STEAM ENGINE COMPANY, Fitchburg, Mass., has been running at its full capacity throughout the hard times on orders for delivery in Japan, Hawaii, Mexico, etc., as well as California and Eastern States. The present wrist-plate cam valve-motion of the Fitchburg engine seems to be entirely satisfactory to all who have investigated its merits. The company guarantees electric railway and perfect incandescent lighting service from the same engine. The 800-hp unit installed for the Louisville Electric Corporation receives universal commendation. Every engine sold adds to the good reputation of the product and the company reports an encouraging outlook for business in 1897.

MR. I. J. KUSEL, president of the Missouri Telephone Manufacturing Company, 917 Market Street, St. Louis, reports that although at the beginning of 1896 his company moved into new quarters it has already become necessary to erect an addition to the building. The orders received during 1896 aggregated more than double those of 1895, and during the last month of the year the heaviest business in the history of the company was transacted. New machinery has been installed, and the increased facilities have resulted in a large business in parts as well as in completed instruments. The company's 1897 catalogue will be large and exhaustive, and will be devoted exclusively to telephones, switchboards and parts.

CHAS. A SCHIEREN & CO., 45 Ferry Street, New York, received an order at noon Dec. 30 for 118 feet of 72-inch 3-ply leather belting from the People's Electric Light & Power Company, Newark, N. J., whose plant was burned out on Tuesday night, Dec. 29. By working several gangs of men all night, Schieren & Co were able to have the belting in complete running order in 28 hours after receipt of order, which is the quickest time on record for an undertaking of this magnitude. They have also received an order for 116 feet of 72-inch 3-ply leather belting from the Brooklyn Heights Railway Company, Brooklyn, N. Y., and one from the North River Electric Light Company, New York City, for 126½ feet of the same material and size.

THE STANDARD PAINT COMPANY, manufacturer of the P. &. B insulating paints and compounds, has received a letter from the director of the Hanover (Germany) Street Railway Company describing its use of the P. & B. compounds in making accumulator boxes. These boxes are made of wood and are thoroughly painted with the compounds, then lined with thin sheet lead, which is, in turn, covered with Ruberoid felt, and again painted thoroughly, inside and out, with P. & B. paint. The results are stated to be the best yet attained, being, in the opinion of the railway management, much better than those formerly secured with rubber boxes. It is an excellent proof of the acid-resisting qualities of P. & B. that it should be satisfactory for this purpose.

THE NON-POLARIZING DRY BATTERY COMPANY, 347 Broadway, New York, is meeting with excellent success in the sale of its "O. K." batteries. Many duplicate orders are being received, which is evidence that although the "O. K." is a comparatively new battery, it is giving splendid satisfaction. Among the good points claimed for this battery are its high voltage, low internal resistance, reliability, perfect insulation, high recuperative power, low cost, long life and the absence of local action, thus preventing it from degenerating when not in use. The manufacturers of the "O. K." draw attention to its usefulness and advantages for all kinds of open circuit work, and for any purposes where a strong, durable and quickly recuperative battery is required.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., announces that it has recently secured the services of Mr T. E. Hughes, formerly manager of the Pittsburg warehouse of the Washburn & Moen Manufacturing Company, and that Mr. Hughes will have charge in the Eastern States of the sale of the magnet, feeder, trolley, weatherproof and rubber covered wires, etc., manufactured by the company. Mr. Hughes' New York address will be Room 18, Times Building. Mr. Geo. L. Wiley, manager of the New York office, will continue in that capacity and will give special attention to lead covered cables, underground conduits and accessories. The friends and customers of this company may rely on receiving careful and prompt attention under the new arrangement.

THE ORIENT ELECTRICAL COMPANY, Youngstown, O., has made an excellent reputation in the trade for its high-grade incandescent lamps. These lamps are efficient, have long life and are moderate in price, quality being the essential feature of the business. The company uses the best materials, apparatus and skill in the production of its lamps, which are carefully tested at every stage in the process of their manufacture. The company has recently enlarged its plant, which enables it to produce a larger output, and at the same time fill orders with greater promptness. The demand for the Orient lamps is so great that the factory is being run at its fullest capacity. Old customers stay with the company, which is evidence that the lamps are first class, although there are other lower-priced lamps in the market.

MR. GODFREY LUTHY, manager Royal Electric Company, Peoria, Ill., reports that his company does a fair share of the business, even in spite of the brisk competition of the larger companies, and this he considers to be due to the efficiency and durability of the company's alternator. People are now wideawake regarding the superior quality, greater safety and less expense in maintenance of the inductor dynamo, which type the Royal Electric Company prides itself on being the pioneers in introducing in America. We are confident, he states, that in 1897 we shall do more than our share of the business, owing to the many radical improvements we have adopted in these machines, though so far as general business is concerned we do not expect normal or flourishing conditions to set in before the Autumn of 1897.

THE CHAS. E. GREGORY COMPANY, Chicago, has just completed the most prosperous year of its existence, in spite of the prevailing general depression of business. The company's latest monthly bargain sheet contains the usual attractive offers of dynamos and other electrical machinery and sup-

plies; special attention is called to the repair department, which has again been enlarged and the facilities increased so that orders are executed with great promptness. The well-known reputation of the house and the value of its guarantee enables the buyer to receive his apparatus with perfect confidence in its reliability, the element of risk, so well known to exist in buying electrical machinery at hap-hazard, being entirely eliminated. The coming year holds still brighter prospects in store for this unique establishment.

ELECTRIC HEATERS.—The Detroit Electric Heating Company, 132 Shelby Street, Detroit, Mich., is making up its multitubular electric heaters in serviceable designs. The portable stove is a convenient device. It is provided with nickeled top and base, the body being of Russia iron. These stoves are designed for warming small rooms, cars, cabins, staterooms, show windows, sleeping rooms, offices, etc., etc., and operate on both the "radiating" and "air circulating" principles. The portable radiator and coach heater is another style embodying the same principles. Several points of superior merit are claimed for these devices, among which may be mentioned large heating surface as a result of the tubular construction, constant circulation of warm air, great durability and few repairs. Ease of repair constitutes another special feature of this make of heater.

THE SHELBY ELECTRIC COMPANY, of Shelby, O., will open its new factory for the manufacture of incandescent lamps during the early part of this month. The company was recently organized with W. W. Skiles, president; A. A. Chaillet, technical manager; J. C. Whiteside, superintendent, and J. C. Fish, secretary. It has erected buildings to accommodate 200 operatives, and the plant will have an ultimate capacity of 10,000 lamps per day. The lamps will be made under the Chaillet system, superior efficiency and large life being the principal claims of excellence. It is also intended to manufacture Crookes tubes and other vacuum apparatus, and a fine research laboratory for experiments on vacuum-tube lighting has been provided It is not expected that the new lamps will compete with existing types in price, but will claim superior excellence solely as the reason for their introduction.

MR. FRANK E. KINSMAN, New York, manufacturer of the "Daylight" desk lamp, claims it to be an advance in the matter of office lighting, particularly as related to roll top desks. The principal objection to previous forms has been their failure to equally distribute the light over the entire surface of the desk. This with the added objection of bunching the light or throwing it all in one spot has led many to adopt cluster or arc lamps suspended from the ceiling for the sake of securing general diffusion. The lamp in question is fixed to the top of the desk in such a manner that it does not interfere with the movement of the roll or shutter and thereby avoids the necessity of lifting it from the desk when it is desirable to close the latter. The diffusion of the light is obtained through the medium of the ground glass lamp. In the case of this lamp the ground glass is turned up instead of down, thereby greatly enhancing the result.

THE INTERIOR CONDUIT & INSULATION COMPANY, New York, has for the past few months exerted its best endeavors to turn out a first-class iron armored conduit which could be sold at a lower price than has heretofore been charged, and thereby assist in cheapening the cost of first-class electrical work. The result is the new and improved iron armored conduit which has just been offered to the trade. This conduit is claimed to be superior to any ever before placed upon the market, while it also possesses additional advantages in that it is extremely light, has a smaller outside diameter for a given internal diameter, and has greatly increased insulating properties. The insulating lining is of a flexible nature, is not affected by bending, and will stand a temperature of 175 degrees Fahr. without becoming softened. Any 10-foot section will show an insulation of 11 megohms after being filled with water for 10 days. This new product has met with prompt recognition by the trade at large, and the Interior Conduit & Insulation Company has still further enhanced the value of its well-known system of electric wiring.

THE GORDON-BURNHAM BATTERY COMPANY, New York, says that 1896 has been practically its first year of business, although an immense amount of experimental work was done, covering many years, before it was decided to place its product upon the market. The warm welcome the battery met in all lines where it has been introduced proves conclusively, Mr. Burnham thinks, the intrinsic merit of the cell. He says he has yet to learn of the first line of business where the Gordon-Burnham primary cell, generating electricity for use on either closed or open circuit, has been tested and found wanting. He adds that in the gas engine field a large number of prominent manufacturers have adopted the batteries for ignition purposes. The work here required is practically closed circuit. In the telephone field the sales are rapidly increasing. A number of municipalities have adopted the cell for police and fire alarm service, and the railway signal companies are using it extensively. Mr. Burnham anticipates a large and profitable business in 1897. In fact, he says he will be disappointed if the present year does not show sales at least 10 times those of 1896.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, 2017 Locust Street, St. Louis, Mo., has just secured a $10,000 order from the Lachine Rapids Hydraulic & Land Company, Montreal, for transformers aggregating upward of 900-kw capacity. Dr. Cary T. Hutchinson is the Lachine Company's electrical engineer and the principal points of the specification were that at the maximum load the 30-kw transformer should have an efficiency of 97 per cent.; from one half to one quarter load, not less than 96 per cent; at one tenth load not less than 80 per cent.; total drop at full load, 2 per cent. The insulation to be guaranteed to withstand a test of 25,000 volts alternating current, continued as long as desired and at arbitrary intervals. The efficiency tests were to be made under the direction of Mr. Hutchinson. The Wagner Company tendered a bid on these specifications, and also submitted specifications for a more efficient transformer, calling for 97.6 per cent. at full load, 97.5 per cent. at one quarter and three quarter load; 92 per cent. at one tenth load. In the contract the Wagner Company guarantees the proper working of the transformers for a period of two years.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., is now celebrating its tenth anniversary. It was just 10 years ago that Mr. Paiste commenced the manufacture of electrical specialties. The company now has over a hundred different specialties, including the well-known "Xntric" switches and various forms of sockets, cut-outs, etc. It was the first to use porcelain in the manufacture of switches and cut-outs. The porcelain used in the Paiste specialties is manufactured by the Imperial Porcelain Works. During the past year the Paiste Company has been busy perfecting machinery for the automatic construction of sockets, thus practically eliminating labor in the manufacture and at the same time improving the quality of the goods. This machinery has been completed and the first products are now being placed upon the market. The business of the H. T. Paiste Company has recently been reorganized by dividing it into two departments, the Eastern and Western. The Western department, both manufacturing and selling, is under the direct supervision of Mr. Edward A. Jenkins, who has for many years been connected with the home office and is well known in the trade.

ELECTRICAL TEST INSTRUMENT INDUSTRY.—If rumor is to be credited, we are likely soon to have in America another manufacturing concern devoted to the production of standard electrical test instruments. The projectors of this new undertaking are, it is understood, negotiating with the receivers of the E. S. Greeley & Co. for the purchase of the entire plant, stock, and good will of the Test Instrument Department of that old corporation. The Greeley Company made a decided success in this line, and at the time of the receivership claimed to be practically the only house in this country that actually manufactured anything like a complete line of electrical testing apparatus. The company did not make voltmeters or ammeters, but this omission the new concern promises to repair. When the amount of profitable attention bestowed in Europe upon the manufacture of test instruments is considered, it would appear that American enterprise must have been neglecting an open opportunity in this direction, especially in view of the phenomenal success that has attended the efforts of some of the American manufacturers of specialties of this character, prominently the voltmeter and ammeter, whereby within five years not only has pretty nearly every foreign instrument of this sort been driven from our market, but American firms in this line are actually establishing manufacturing plants in Europe. There is not, in the opinion of those in the trade, any good reason why an important business, based upon the Wheatstone bridge alone, cannot be established, with due effort and intelligence, as the requirements for this instrument are growing rapidly from year to year, while the demand for the Greeley instrument of this type is said to have reached quite large proportions.

THE PHŒNIX CARBON MANUFACTURING COMPANY, St. Louis, Mo., of which Col. S. G. Booker is superintendent, held its annual meeting on Dec. 8, and the report of the past year's business was so satisfactory and the outlook for the future so encouraging that Superintendent Booker was authorized to purchase, and has since bought, a plot of ground 150 by 313 feet, immediately north of and adjoining the company's present spacious plant, which will now be enlarged and extended. When this is accomplished the Phœnix Company will be one of the largest and best equipped carbon factories in the country. The company's products are well and favorably known throughout the trade, and include in addition to electric light carbons, high-grade carbon brushes for generators and motors, battery material, carbons for telephones, and in fact carbons for every known use, including purposes for which the use of carbons was not thought of five years ago. The excellent quality of its output and the increased facilities which it will now have, coupled with the prospects of returning business activity, should certainly produce a most satisfactory result for this progressive company.

COL. S. G. BOOKER.

MR. HAROLD P. BROWN, 68 Broad Street, New York, manager of the Edison-Brown plastic rail bond, informs us that his factory has been running to its full capacity so far during the Winter by orders from La Capital Tramways Company, of Buenos Ayres, Argentine Republic; two roads in New South Wales; the Fairmount Park Railway, Philadelphia; the Consolidated Traction Company, Newark, N. J., and others. Also for orders from the new power-house of the Edison Company in Philadelphia, the Chicago City Railway Company, and others for the Edison flexible solder on unsoldered copper contacts, on bus-bars, switchboards, dynamos and motor connections, switches, fuse blocks, cable junctions, instrument terminals, etc; also for steel and copper contacts on rail bonds, rail feeders, pipe feeders, cable terminals for loops around switches, crossings and special work, etc. The following letter which has been received by us will be of interest in this connection:

"I have heard it recently stated as an objection to the Edison plastic rail bond that the amalgam would harden. As I had a very long experience with the earlier forms of this alloy designed by Mr. Edison, I wish to say that on a road in Orange the bonds were mixed so as to harden, and had four or five years' successful use. If a connection jarred loose from any cause the heat produced by increased resistance quickly softened the amalgam and re-established the contact. In designing the more modern forms of this bond it was decided to put in a slight excess of mercury and to allow sufficient room in the receptacle holding the alloy to prevent its being put under pressure. This alloy when properly used will remain plastic for years, as I can testify from long experience If this alloy is put under pressure the excess of mercury is forced out, leaving a brilliant white metal of great density and of better conductivity than the plastic form. It readily softens under heat, and will not be blackened by an arc. Roads whose joints are well maintained need not worry about contact if their plastic alloy is found hardened. Very truly yours,

"LAKE ONTARIO & RIVERSIDE RAILWAY COMPANY.
"*F. H. Tidman, Receiver.*"

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Dec. 26, 1896.

ELECTRICAL STOCKS.—No particular activity is shown by the quotations of this class of securities. In common with the general list, the market was quiet, as is usually the case during the holidays. Edison Illuminating Company, of New York, advanced one point, and General Electric issues show fractional improvement.

TELEGRAPHS AND TELEPHONES were, on the whole, weaker than they were the week previous. Declines were the rule. The closing quotations, as compared with those of the week previous, show declines as follows; Bell Telephone, ½; Erie Telephone, ¾; Postal Telegraph, 1. Western Union was the only exception to the general falling off in prices, and closed at an advance of ¼ point.

ELECTRIC TRACTION.—The changes recorded in the street railway list are largely on the negative side, save in two cases, *viz.*: Baltimore Traction and Worcester Traction preferred. The rest of the list shows dealing as compared with last week's closing quotations. The principal changes were: Cleveland Electric Railway, 2 off; North Shore Traction preferred, 5, and West End, Boston, 2½.

STATEMENT OF EARNINGS.—The Edison Electric Illuminating Company of Brooklyn reports gross earnings for the month of November of $79,504, an increase of $1876 as compared with the same month last year, and net earnings of $35,981, an increase of $1938.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	100½	102
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	27	28
Electric Storage, pref	100	29	30
General Electric	100	31⅞	—
General Electric, pref	100	70	73
Westinghouse Consolidated, com	50	25	..
" " pref	50	50	52
BONDS.			
Edison Electric Ill., New York	105	106¾	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	91¼	—
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	209½	210½
American District Telegraph	100	*29	39
American Telegraph & Cable	100	85	88
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	172
Erie Telephone	100	64½	65½
New England Telephone	100	103	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	82¼	82½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19¾	—
Brooklyn Rapid Transit		18½	20
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	74	77
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	41	44
Hestonville	100	51	51¼
" pref		..	62½
New Orleans Traction	100	10	12
" " pref	100	40	50
North Shore Traction	100	21	24
" " pref	100	72	78
Rochester St. Ry	..	16	19
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	63	64
" " pref	100	84	86
Worcester Traction	100	18½	20
" " pref	100	94	97
BONDS.			
Brooklyn Rapid Transit 5s. 1945	100	77¾	..
Buffalo St. Ry. 1st con. 5s	100	*105	108
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	98
Union Railway (Huckleberry) 1st mtge 5s		*101	104
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest

THE MICHIGAN TRUST COMPANY, Grand Rapids, Mich., has taken charge of the Lowell Water & Light Company, the Peninsular Light, Heat & Power Company and the Western Michigan Electrical Company. This action as brought about at the instance of the bondholders and unsecured creditors, representing $140,000. The three companies are practically one.

COMMERCIAL CABLE AND POSTAL TELEGRAPH INTERESTS.—The shareholders of the Commercial Cable Company held a special meeting on Dec. 23, at which the plans for unifying the interests of that company with those of the Postal Telegraph-Cable Company were unanimously adopted. The plan provides for the issue of $20,000,000 bonds, $15,000,000 of which is to be paid for the plant of the Postal Telegraph Company, and the balance of $5,000,000 will be used in the extension of the telegraph lines. The bonds will bear 4 per cent. interest, which will be paid in gold quarterly. Registered bonds will be issued of the denomination of $100 and upward, these denominations being suitable for small investors. The shareholders of the Postal Telegraph Cable Company also held a special meeting on the same day and ratified the plan.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Dec. 31, 1896.

MR. JOS. F. O'DAY is the latest addition to the forces of Thos. J. Fay & Associates, electrical engineers and contractors, 143 Liberty Street, New York.

MR. J. F. OUTWATER, who has represented Mr. Hugo Reisinger, of 38 Beaver Street, New York, will resign his position to return to the Edison Electric Illuminating Company, of Brooklyn, with whom he was formerly connected for eight years. Mr. Outwater leaves Mr. Reisinger with the latter's best wishes for success in his new and important position as purchasing agent.

THE EAST RIVER TUNNEL.—At Albany, on Dec. 23, the State Railroad Commission granted the application of the New York & Brooklyn Railroad Company for permission to construct a tunnel between the cities of New York and Brooklyn, under the East River. The permission is given without prejudice to the rights or interests of the New York & Brooklyn Tunnel Company or the Brooklyn, New York & Jersey City Terminal Railroad Company, which companies were organized for similar purposes.

GENERAL MANAGER WM. M. HABIRSHAW and Messrs. J. W. Godfrey, F. W. Harrington and J. B. Olson, of the India Rubber & Gutta Percha Insulating Company, gladdened the hearts of their friends by sending them invitations to be present at their office, 15 Cortlandt Street, New York, on Thursday afternoon, Dec. 31. The pleasant anticipations of those who were fortunate enough to attend were fully realized and all went away confirmed in the opinion that the gentlemen connected with the India Rubber & Gutta Percha Insulating Company are delightful entertainers.

CAR SHED AND CARS BURNED.—On Dec. 27 the Ridgewood car shed of the Brooklyn Heights Railway Company at Myrtle and Wyckoff Avenues, Brooklyn, was partially destroyed by fire. The building was of brick with iron supports, and was constructed in 13 sections, six of which were entirely consumed. A large number of open and closed cars were stored in the building. The fire spread rapidly, and consumed in addition to a portion of the building 10 open cars, two closed cars and two sand cars. It is stated that the damage to the railway property amounted to $30,000.

MUNICIPAL OWNERSHIP IN BROOKLYN.—Resolutions were offered at the meeting of the Board of Aldermen in Brooklyn on Dec. 21, favoring the establishing of electric light and gas plants by the city. Alderman Francisco offered an amendment to the resolution providing that all railroads in the city be included, and another amendment was offered to include the telephones in the provisions of the proposed ordinance. The proposition was laid on the table. One of the aldermen remarked that the effect of the ordinance, if it became law, would be to bankrupt the city if it attempted to purchase the railroads.

INCLINED ELEVATOR AT THE BROOKLYN BRIDGE.—A public test is being made at the New York entrance to the Brooklyn Bridge railway station of the Reno inclined passenger elevator. The object of the inventor is to demonstrate the utility of this apparatus for elevating passengers from a lower to a higher level. The apparatus is, strictly speaking, a movable stairway. The Bridge trustees tried it privately last Thursday and were apparently delighted with its operation. The machine was thrown open for the public test this week. This device was fully described and illustrated in THE ELECTRICAL WORLD of Nov. 7, last.

MR. CHAS. D. SHAIN, the occasional poet of 136 Liberty Street, New York, has broken out again in that line. He has sent to his friends a postal card with the following poetic advice for 1897:

"A cheerful start with your affairs well in hand,
"A spurt for the wire and a winner you'll land."

Several of Mr. Shain's admirers who remember how sleek and well-favored he is, and the weight at which he "tips the scale," are asking with bated breath whether if "Charlie" himself should undertake "a spurt for the wire" he would prove a winner, or whether "Charlie," wire, poem and all wouldn't promptly "land" on the ground?

NEW ELECTRIC CONDUIT RAILWAYS IN NEW YORK.—The directors of the Metropolitan Traction Company have authorized President Vreeland to execute contracts for the equipment of the Fourth, Sixth and Eighth Avenue

street railway lines with the underground electric conduit system. It is expected that the work of changing these lines from horse to electric power will be commenced as soon as possible in the Spring, and that it will be finished by the end of the year. The Sixth and Eighth Avenue lines will be only partially equipped electrically at first—the Sixth Avenue line below Fifty-ninth Street and the Eighth Avenue above Fifty-ninth Street, the conduit being extended through Fifty-ninth Street to connect the main lines.

PORTRAITS OF BENJAMIN FRANKLIN.—The January number of *McClure's Magazine* contains 15 portraits of Franklin, which are certainly known to have been made from life. The reproductions are made direct from the original pictures, and the 15 together give the present-day reader an excellent idea of how the great philosopher appeared in life. The series cover the period of Franklin's life extending from about 1751 to 1787, three years before his death. Nearly every one associated with the electrical professions and industries takes a more or less keen interest in Franklin's work, and they will be pleased to know of so excellent an opportunity to obtain authentic portraits of this man, for whom so many entertain a feeling of admiration and respect.

TWENTY-FIFTH ANNIVERSARY OF THE STEVENS INSTITUTE OF TECHNOLOGY.—A noteworthy event in the annals of technical education in the United States will be the forthcoming celebration of the twenty-fifth anniversary of the Stevens Institute of Technology, Hoboken, N. J., on the 18th and 19th of February next. The festivities will consist of a banquet at the Hotel Waldorf, New York, to which representative engineers and technical educators throughout the country will be invited, and on the following day the Institute will be open for inspection. A reception tendered to the faculty, graduates and undergraduates will be held by Mrs. E. A. Stevens, widow of the founder of the Institute, at Castle Point, Hoboken, and a promenade concert and dance in the evening will conclude the celebration.

NEW MANAGEMENT OF THE C & C ELECTRIC COMPANY.—Changes have recently occurred in the *personnel* of the C & C Electric Company, New York, indicating the inauguration of an active and progressive management with the new year. Mr. D. W. Barnes, who has accepted the position of general manager, has long been connected with the company, filling offices of greater responsibility with the succeeding years. His thorough electrical and mechanical knowledge and practical experience of shop work, together with the marked ability he has shown in the management of the departments heretofore under his charge, give assurance of the company's continued and increased success under Mr. Barnes' management. We learn that the company already has several new designs both in the line of motors and dynamos well advanced, which will shortly be brought before the public. The foreign, advertising and purchasing departments are in charge of Mr. C. H. Florandin, whose connection with this company and whose previous connection with the Brooklyn Heights Railroad Company have made him many friends both in New York and Brooklyn. The changes are not, however, confined to the factory and home management of the company. In addition to the branch offices in Boston and Philadelphia, which have long been in operation, and those in St. Louis and Chicago, of more recent establishment, the C & C Electric Company proposes to reach for Southern business, and with that end in view will open an office in Atlanta, Ga., under the management of Mr. Campbell Scott, of Louisville, whose past career with the Gaynor Electric, the Sprague and the Edison General Companies is a sufficient guarantee that this new office will be conducted on straightforward business principles. Indications are therefore that the C & C Electric Company proposes to secure its share of the trade of 1897, and it is to be congratulated on its selection of agents to accomplish this result.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Dec. 30, 1896.

NEW TELEPHONE COMPANIES FOR BUFFALO.—Two new telephone companies have organized and propose to get new subscribers by materially reducing rates. They are the Home Telephone Company and the Automatic Telephone Company. The Home Telephone Company has been working the field only a few weeks, but according to Mr. P. H. Adams, its manager, over 1000 subscribers have already been secured, and as its rates are only $3 per month for residences and $4 for business places, many new ones are being secured. The company will soon apply for a franchise.

THE BUFFALO TELEPHONE COMPANY.—Dr. Harrison T. Chamberlain has applied to the Buffalo Board of Aldermen for a franchise for the Buffalo Telephone Company. The company proposes to charge $30 a year for residence service and $40 for business.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Dec. 30, 1896.

MR. CHAS. N. WOOD, manager of the New York office of the Frank Ridlon Company, was a Boston visitor this week. The electrical element of New York City will find Mr. Wood a valuable acquisition, but the Boston element is congratulating itself that it does not lose him entirely, as his visits will be of frequent occurrence.

THE KENT ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., has lately been bending its energies to the application of alternating current for small power purposes. Its new alternating-current sewing machine motor is one of the most radical of its devices. The company is about to bring forward a dental engine to run on alternating circuit that is said to be quiet-running, with good speed regulation.

THE FRANK RIDLON COMPANY, 180 Summer Street, Boston, Mass., announces that it has various second-hand electrical apparatus now ready for delivery. The list includes railway generators and motors, stationary motors, incandescent and arc dynamos, arc lamps and transformers. Every machine is thoroughly tested before shipment. The Ridlon Company is represented in New York by Mr. Charles N. Wood, Room 131, 80 Broadway.

MR. F. N. PHILLIPS has assumed the position of treasurer of the American Electrical Works, Providence, R. I., made vacant by the resignation of Mr. W. A. Hathaway, and his brother, Mr. E. Rowland Phillips, has been appointed superintendent of the works. Both are sons of Mr. Eugene F. Phillips, president of the company, one of the best known and most highly esteemed men in the business. THE ELECTRICAL WORLD congratulates the Messrs. Phillips upon the "new departure" and wishes them and the American Electrical Works continued success and prosperity.

THE MOSSBERG & GRANVILLE MANUFACTURING COMPANY, 101 Sabin Street, Providence, R. I., a notice of whose incorporation and removal to new and larger quarters appeared in THE ELECTRICAL WORLD, of Dec. 19, is manufacturing a line of presses which are particularly adapted to the rapid production of sheet metal stampings and of drop forgings for electrical use. Commutator bars and segments, brush-holders, incandescent lamp sockets, plain and ornamental stampings for electrical work can be rapidly and economically produced by their means. Among the company's specialties is a press which will punch armature sheets at one operation, a great saving over the old-fashioned ratchet dial feeding in common use. This firm may well be called the headquarters for presses.

THE STRIKE OF THE CONDUCTORS AND MOTORMEN of the West End Street Railway Company, Boston, on Thursday, Dec. 24, occurring as it did right on the eve of Christmas and in the midst of a severe snow storm, imposed extra hardship on the traveling public. Be it said, however, to the credit of the Conductors' & Motormens' Union, the strike had been declared "off" until after the holidays, out of consideration to the inconvenience that would be occasioned the public, but unfortunately the order did not reach in time some of the divisions of the road, thereby leading to confusion and misunderstanding by the men, until the strike became almost general. On Christmas Day with the return of quite a number of the old men and the employment of new men, all the lines were running quite regularly. At the present writing about 800 of the old men have lost their positions, which have been filled by new men, and the company claims to have all the men it needs to operate the road. Through public meetings the Conductors' & Motormens' Union is endeavoring to justify the course it has taken, and has aroused to a considerable degree favorable public sentiment, and while the position taken by President Little receives many words of commendation, regret is generally expressed that the grievances of the men could not have been settled by arbitration, as no street railway company could boast of a better or more orderly and capable working force.

THE ELECTRIC POTENTIAL CLUB, of Boston, gave its first dinner of the year at Hotel Thorndike, on Wednesday evening, Dec. 23. After the dinner Caryl D. Haskins read a paper on "Submarine Torpedoes as Applied to Modern Naval Warfare," the paper being quite fully illustrated by stereopticon views. Mr. Haskins divided his paper into two headings, the first division dealing with fixed torpedoes, or submarine mines; the second division dealing with spar, automobile and dirigible torpedoes. In speaking of fixed torpedoes, the methods now in use by the British Government were selected as being the most typical and also the most highly perfected. Attention was particularly called to the fact that during our own civil war, when the torpedo was as yet a quite undeveloped device, some 30 vessels were destroyed by torpedoes. It was pointed out that there were three general types of fixed torpedo for deep water service which might be classed under the headings of observation mines, being fixed torpedoes carrying from 300 to 500 pounds of wet gun cotton, and intended for exploding by means of a contact key on shore, and being, in practice, generally exploded in groups. Second, electro contact mines, carrying charges from 50 to 100 pounds of wet gun cotton, and intended for explosion by contact with the ship, but controlled by the shore observer by reason of his ability to make them active or inactive at will. Third, electro-mechanical mines, similar in every respect to electro contact mines except that they were under no outside control, and were exploded by any craft coming in contact with them. It was pointed out that this latter class of mine would probably be used but little in future warfare, as it menaced seriously the safety of friendly craft, and had nothing to recommend it other than that it could be planted with far greater rapidity and ease than any other type. The exploding devices and general structure of all of these mines was described very fully and diagrams shown of their internal structure. In dealing with spar torpedoes Mr. Haskins stated that, contrary to general belief, they would probably be used to a considerable extent in future wars, and confirmed this statement by citing the fact that they were still served out in the British service to all cruisers destined for foreign stations and carrying launches sufficiently heavy for use as improvised torpedo boats. Under the heading of automobile torpedoes, Mr. Haskins fully described the Whitehead torpedo and its mechanism and gave a brief history of its conception and development. Mr. Haskins expressed his belief that the Whitehead torpedo was by far the best device of the kind as yet invented, and the speaker at this point took occasion to make an earnest plea for a popular demand for an adequate outfit of torpedo boats and torpedoes for the United States government, calling to mind the fact that our fleet of torpedo boats was only about one one-hundreth of what it should be. He further advocated the manufacture and use as a government standard of the 18 inch type of modern Whitehead. After describing fully the method of discharge and the method of aiming the Whitehead torpedo, Mr. Haskins briefly referred to certain other promising types, but omitted purposely, as he very frankly stated, any discussion of the Howell torpedo, which he described as being too important to be passed over without a full description, which he himself did not feel competent to give. In referring to the accuracy of torpedo flight, Mr. Haskins pointed out that the best European naval authorities claimed that about one hit in ten only could be expected in actual action. He however said that despite the fact that the accuracy to be anticipated is at present low, it was probably safe to expect that the existing inaccuracy will be largely corrected by the addition of a further automatic mechanism, which shall take the steering of the torpedo under its control when in the neighborhood of the target, and shall by means of a quite simple device control the rudder and steer the torpedo for the centre of the mass of the attacked, pro-

vided the torpedo during the course of its flight comes within a distance of the ship attacked amounting to half the length of that ship. Such a device, the speaker said, has already been designed, constructed and tested. Referring to dirigible torpedoes, the Brennan, the Edison Sims and the Halpine devices were selected as typical of their class. In conclusion Mr. Haskins drew the probably just inference that for defensive purposes more security could be obtained for a given expenditure by the building of an adequate number of torpedo boats, with a reasonable battleship support, than by any other means. The paper was discussed very ably and fully by Col. Mansfield, U. S. A., Corps of Engineers; Capt. Eaton, U. S. N.; Lieut. Fry, Massachusetts Naval Militia; Lieut. Sweet, Massachusetts Naval Militia, and Lieut. Frye, Adjt. First Regiment Massachusetts Volunteer Militia. The meeting was ably presided over by Mr. Frank Ridlon, president of the club.

Philadelphia Notes.

Branch Office of The Electrical World,
927 Chestnut Street,
Philadelphia, Pa., Dec. 30, 1896

THE ELECTRIC PROTECTION COMPANY, Philadelphia, Pa., announces that Mr. A. L. Fenton's connection with that company terminated on Jan. 1, 1897, and that Mr. Charles D. Shain, 136 Liberty Street, New York City, will be the company's sales agent for the States of New York, Connecticut and that part of New Jersey north of Trenton.

MORSE, WILLIAMS & CO., Philadelphia, Pa., the well-known builders of passenger and freight elevators, have lately completed their contract for the two new hydraulic passenger elevators for the Hotel Aldine, Philadelphia. Other contracts under way are the Mechanics Bank, Brooklyn, and John Otto, Jr., Buffalo, N. Y., each for two electric passenger elevators, and Howell Block, Los Angeles, Cal., three electric freight elevators.

WOOD & COMER, LTD., 130 Juvenal Street, Philadelphia, Pa., manufacturers of chemical apparatus, who are introducing a very excellent vest-pocket polarity indicator, report that they are being forced more and more into the electrical field. Ozonometers, chemical voltmeters, electrolytic supplies, special delicate thermometers, hydrometers for storage and other batteries, Geissler and Crookes tubes are a few of the many electro-chemical specialties manufactured by them, demonstrating the increasing number of points of contact between chemistry and electricity.

THE TECHNIC ELECTRICAL WORKS have made the following changes in their management: Mr. G. M. Sinclair, formerly vice-president, has resigned, and is succeeded by Mr. J. J. Zimmerlee, formerly secretary and treasurer. The office of secretary and treasurer has been filled by Mr. Richard L. Binder, whose experience in the manufacturing business will make him a valuable addition to the works. The Technic Electrical Works report since moving into their larger quarters on New Street that their business has increased very materially, and they are now in a position to fill orders promptly.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., Dec. 30, 1896.

NORTHWESTERN ELECTRICAL ASSOCIATION.—Mr. George Cutter, 815 The Rookery, Chicago, informs us that he has been asked by Secretary Mercein to take charge of the Chicago delegates to the convention of the Northwestern Electrical Association, which will be held at the Hotel Pfister, Milwaukee, Wis., on Jan. 20 and 21 next. It is expected that the Chicago delegates will travel to Milwaukee on a special car, leaving Chicago at 8.30 a.m., Jan. 20, over the Chicago & Northwestern road. All delegates wishing to go on this car should communicate with Mr. Cutter.

MR. E. W. HAMMER, late secretary of the Cutler-Hammer Manufacturing Company, Chicago, has sold his interest to Mr. Horace S. Smith and Mr. Harry H. Cutler. Mr. Smith is well known to the mechanical world as the late general manager and vice-president of the Illinois Steel Company, and Mr. Cutler needs no introduction to the electrical trade. The company has been reorganized and placed upon a sound financial basis, with a largely increased capital. Its factory is being enlarged to take care of the rapidly growing business, and to better enable it to keep up its reputation for high-class work and prompt shipments.

St. Louis Notes.

St. Louis, Dec. 24, 1896.

ARC LIGHTS TO BE LOWERED.—The Board of Public Improvements has ordered that arc lights in the central part of the city be lowered to a uniform height of 20 feet.

FRANCHISE FOR A NEW COUNTY ELECTRIC LINE.—A new corporation filed a petition with the County Court at Clayton for a franchise for the construction and operation of an electric railway, and the company promises to commence the construction of the road within 18 months after the franchise is granted.

SUTTER BILL VETOED.—The bill granting the Underground Telephone & Telegraph Company a franchise to construct conduits all over the city, and in a fashion of its own, and known as the "Sutter Bill," from the name of the principal promoter, was vetoed by the Mayor Tuesday. It will not likely be passed over the veto.

EXPERT OPINIONS.—The special committee of the Board of Public Improvements met last Monday to hear opinions from experts as to the practicability of placing high and low tension wires in the same conduits, but in different ducts. Fifty representatives of the various electrical companies were present. The general impression of the experts seems to be that there would be no objection to having telegraph and telephone wires in one conduit and electric light and power wires in another. Only three or four were of the opinion that putting both classes of wires in the same conduit would be practical.

Canadian Notes.

Montreal, Can., Dec. 25, 1896.

PARRSBORO, N. S.—The question of lighting the town by electricity is now under consideration.

GUELPH, ONT.—The by-law to provide funds for purchasing an electric light plant will be submitted to the ratepayers.

ELECTRIC RAILWAY PROJECTED.—A project has been mooted to construct an electric railway from Parry Sound, Ont., to Ahmic Arbor.

CHATHAM, ONT.—The City Council has decided to submit a by-law to ratepayers for the expenditure of $15,000 for a civic electric light plant.

TO PURCHASE AN ELECTRIC ROAD.—Messrs. Hoffmann & McLelland, of Berlin, are negotiating for the purchase of the St. Thomas street railway.

TURKEYS AND PLUM PUDDING.—The Montreal Street Railway Company distributed among its employees six tons of turkeys and three tons of plum puddings, as Christmas gifts.

THE CANADIAN PACIFIC RAILWAY COMPANY will apply to Parliament at the next session for an act confirming an agreement dated March 16, 1896, between it and the Hull Electric Company, whereby the Canadian Pacific Railway undertook to lease what is known as its Sylmer Branch to the Hull Electric Company for a period of 35 years at a rental of $5000 per annum.

Ottawa, Ont., Dec. 26, 1896.

THE BELL TELEPHONE COMPANY intends to erect a building to be used for the purpose of an exchange, in Westmount, at the corner of Metcalf Avenue and Sherbrooke Street, Montreal. The foundations have been built.

APPLYING FOR A CHARTER.—The Fort Erie & Bridgeburg Street Railway Company is applying for a charter to construct and operate an electric street railway in the towns above mentioned. The capital is $50,000. S. Henry Runcie, William Douglas, Chester Norris, Elias Oviatt and William German are to be the first directors.

POWER HOUSE.—Tate's old saw mill, Mill Street, is now being converted into a power house for lighting the Lachine Canal. The old wooden structure, just opposite, which was erected for this purpose some years ago, is considered too small to accommodate the large plant necessitated by the increased number of arc lights. Large turbine water wheels are now being put in their respective places and will be ready in the Spring.

TELEPHONE SERVICE IN TORONTO.—The Civic Board of Control has received tenders for telephone service. The Automatic Telephone Company's offered rates are, for offices, $36 per annum; for houses. $20, with a percentage to the city of 6 per cent. on gross earnings. The other tender was from the Wilhelm telephone system of Buffalo. The offer is for a 10-year renewable term, and the price $32 50 for offices and $18.50 for residences. The specifications accompanying the tenders were referred to the engineer for an opinion as to the relative values of the two offers, and the likelihood of sufficient security being forthcoming to warrant the city in putting in any second system.

COST OF ELECTRIC LIGHT IN CANADA.—A report has been prepared as to the cost of electric lighting in various places throughout Ontario. Chatham, 65 lamps, all night, 23½ cents each per night; Brantford, 55 lights, all night, 23 cents; Cobourg, 23 lights, till midnight, 21 cents; Port Hope, 33 lamps, till midnight, 15 cents; Peterboro, all night, 25 cents; Kingston, 105 lights, all night, 24½ cents; Ingersoll, 36 lights, till midnight, 20 cents; Woodstock, 70 lights, till midnight, 19 cents; Belleville, 61 lights, all night, 24 cents; Galt, 50 lamps, till midnight, 21 cents; Hamilton, 369 lights, all night, 25 cents; Guelph, 90 lights, all night, 24½ cents; Owen Sound, 30 lamps, all night, 30 cents; London, 300 lamps, all night, 30 cents.

English Notes.

(From Our Own Correspondent.)

London, Dec. 16, 1896.

THE TRAMWAY QUESTION AT BRISTOL.—The Bristol Town Council having decided to insist upon supplying the electric current for the proposed electric tramways in this town, the local tramway company has decided not to proceed any further with its application for power to work its line by electricity.

HOUSE WIRING.—The Council of the Society of Arts recently offered a prize of £25, called the "Fothergill" prize, for a paper on "The Best Means of Effectually Preventing Leakage of Current to Earthing Electrical Installations from Generating Heat and Setting Buildings on Fire." This prize has been obtained by Mr. F. Bathurst, who, I believe, advocated interior conduit wiring.

TELEGRAPHY WITHOUT WIRES.—Mr. Preece went down last week to the East End and delivered at Toynbee Hall his latest revelation on the subject of telegraph without wires, introducing his latest protégé, Signor Marconi, to the admiring gaze of the East Enders. He stated he had persuaded the Government to grant a large sum to this adventurous Italian gentleman for the purpose of carrying out, on a still more extensive scale, experiments in the direction of induction telegraphy.

INSTITUTION OF ELECTRICAL ENGINEERS.—A new custom was inaugurated at the annual general meeting of the Institution of Electrical Engineers last week, inasmuch as, for the first time in the history of this institution a whole evening was devoted to the amicable discussion of its affairs, no paper being read or discussed. The meeting completely justified these who asked for one evening a year to be set aside for this purpose, as innumerable suggestions likely to be fruitful in the immediate future were made by the various members present. The financial position of the in

stitution seems excellent, but good papers are still lacking. A fillip would probably be given, if one of our native millionaires were to found a really substantial premium and a medal connected with the name of some illustrious electrical physicist, such as Kelvin, Faraday or Maxwell. At present the premiums offered by the Institution of Electrical Engineers for papers read before it during the session are of an extremely meagre character. So poor were the papers read during the past 12 months that the institution only awarded one of the three small premiums at its disposal, and that went to three very junior members. Indeed, judging by the eulogistic remarks of the Council upon the papers at its students' meetings, it would seem as if the students were better hands at this sort of thing than their elders.

General News.

NEW INCORPORATIONS.

THE WHITNEY ELECTRIC LIGHT COMPANY, Whitney, Ind., has been organized with a capital stock of $10,000.

THE CHICAGO, LEMONT & JOLIET ELECTRIC ROAD has been formed by E. H. Heilbronn, S. T. Hart, E. D. Hopkins, G. Lawrence Taylor and D. C. Baldwin

THE KOKOMO TELEPHONE COMPANY, Kokomo, Ind., has been formed by P. C. Brown, S. W. Moon and P. W. Bossart. The capital stock of the company is $10,000.

THE JERSEY-UNION TELEPHONE COMPANY, Jerseyville, Ill., has been formed with a capital stock of $2500. The incorporators are William H. Fulkerson and Andrew W. Cross.

THE WINDMILL ELECTRIC COMPANY has been incorporated in New York City, with a capital stock of $100,000. The incorporators are W. S. Townsend, R. D. Lankford and R. J. Henderson.

THE DUBROW INCANDESCENT COMPANY, Cleveland, O., has been formed with a capital stock of $30,000. Those interested are John H. Dubrow, Arnold C. Saunders, Andrew Squire, F. M. Folsom and W. U. Maitors.

THE WIZARD MANUFACTURING COMPANY, Chicago, Ill., has been formed with a capital stock of $150,000, for the purpose of manufacturing electrical goods. The incorporators are Milton M. Kohn, Morris T. Kendig and Carlos S. Hardy.

THE NEWTOWN ELECTRIC RAILWAY COMPANY, Newtown, Pa., has been incorporated with a capital stock of $100,000. The incorporators are Thomas P. Chambers, George C. Worstall, James C Hutchinson, Asbel W. Watson and others.

THE HAMILTON ELECTRIC COMPANY OF PHILADELPHIA, PA., has been incorporated with a capital stock of $5,000. The incorporators are Philemon P. Bowers, William J. Moor, William King, Louis W. Moore, and William S. Kimball.

THE SAN FRANCISCO GAS & ELECTRIC COMPANY has been incorporated at San Francisco, Cal, with a capital stock of $20,000. This company will succeed the San Francisco Gas Light Company and the Edison Electric Light Company. The incorporators are J. B. Crockett, Adam Grant, Levi Strauss and others.

TELEGRAPH AND TELEPHONE.

LITTLE ROCK, ARK.—There is some talk of building a telephone line between Arkadelphia and Amity, in this State.

BURLINGTON, ILL.—The Henderson County Telephone Company has been granted a franchise to extend its service to and in this place.

GOSHEN, IND.—A franchise has been granted to Messrs. Griffith and Long to construct a telephone line between Goshen and Lagrange.

MUSKEGON, MICH.—The line of the Citizens' Telephone Company between Grand Rapids and this place has been completed and is now in working order.

MARSHFIELD, WIS.—The Wood County Telephone Company was recently organized in this county for the purpose of supplying this section with telephone facilities.

MARION, MASS.—Benjamin F. Waters, manager of the telephone exchange, is to build an electric light station at this place. It will be ready to operate May 1, next.

CHATTANOOGA, TENN.—A telephone line is being constructed from the headquarters of the Commission at Chickamauga Park to the commissioner's office in the Custom House in this city.

ST. JOSEPH, MO.—The Missouri & Kansas Telephone Company has moved into its new exchange on Seventh Street, this city. The building is said to be the finest in St. Joseph, and it was especially designed for telephone purposes.

KNOXVILLE, TENN.—The East Tennessee Telephone Company is preparing plans for the improvement and extension of its lines within the corporation limits. The company also proposes to run new cables and erect new poles.

LOUISVILLE, KY.—The Home Telephone Company has commenced the stringing of its wires, and expects to have the system in operation by the latter part of January next. The new exchange will be located in the Bigg Building, on State Street.

PONTIAC, ILL.—A franchise to establish a telephone exchange in this place has been granted by the City Council to Mr. Hartley, of Indiana. The prices to be charged for the service are said to be $1 per month for residences and $2 per month for business purposes.

MASSILON, O.—A franchise was refused the American Telephone & Telegraph Company by the City Council, because the company would not agree to treat the opposition local exchanges on equal terms. This is the second time that the company has applied for a franchise and failed.

MOLINE, ILL.—The plant of the new Tri-City Telephone Company in Fulton, Ill., and Clinton and Lyons, Ia., has been completed and turned over to the company. The exchanges begin with a good-sized list of patrons. The business is conducted in opposition to the Bell Company.

NEWARK, O.—There is some talk by the members of the Ohio Telephone Exchange Association of organizing a new company to inter-connect 60 exchanges in Ohio, 45 in Indiana, and several in other adjoining States. A meeting is soon to be held in Columbus to take action in the matter.

BROKEN ATLANTIC CABLE.—The cable steamer *Minia*, which has been endeavoring to repair one of the Anglo-American submarine telegraph cables on the Grand Banks of Newfoundland, has failed for the second time to accomplish the object, owing to the prevailing stormy weather in that locality. The *Minia* returned to St. John's, N. F., on Dec. 24, and will abandon further efforts to repair the broken cable until Spring.

TUSCOLA, ILL.—The Interstate Telephone Company, which was recently chartered, intends to build telephone toll lines throughout the State. It is said that the Todd automatic connections will be used on the toll lines and the Strowger automatic exchange system will be installed in the towns. The lines will be extended to Hammond, Monticello, Bement, Cerro Gordo, Deland, Decatur, Clinton, Sullivan and intermediate places. The capital of the company is $50,000, and the names of the officers are A. W. Wallace, president; John T. Todd, secretary; S. S. Goehring, treasurer.

ELECTRIC LIGHT AND POWER.

ASHTON, ILL.—Ashton is talking of putting in an electric light plant.

SAYVILLE, L. I., N. Y.—The electric light question is again being agitated at this place.

CEDAR FALLS, IA.—A 20-year franchise for lighting the city by electricity has just been granted by the Council to B. S. Wilder.

MINNEAPOLIS, MINN.—The St. Louis Park Electric Light Company is seeking for a franchise to extend its line to Lake Minnetonka.

CAMBRIDGE, O.—At the meeting of the Council, Dec. 10, the proposition that the city build an electric light plant at a cost not to exceed $18,000 was carried.

JEANNETTE, PA.—It is rumored that eastern capitalists have selected the site and will erect a large electric light plant at this place. Application for a charter will be made in January.

INDIANAPOLIS, IND.—It is the intention of the Board of Public Works to establish an electric lighting plant at the City Hospital, if the amount available is sufficient. Bids will be advertised for.

THE CONCORD LAND & WATER POWER COMPANY, Concord, N. H., is about to install an auxiliary steam plant of about 650 horse-power for use during freshets and when troubled by anchor-ice, etc.

GREELEY, COL.—At a meeting of the City Council held Dec. 15, the Committee on Electricity was instructed to look up the matter of installing a city lighting plant in connection with the city water works.

CORNING, IA.—The plant of the Corning Electric Company was destroyed by fire on Dec. 27. Its capacity was 1,000 incandescent lights, and it was equipped with Westinghouse apparatus. The plant will be rebuilt at once.

DOVER, N. H.—Hon. W. T. Cobb, of Rockland, Me., a few days ago bought at auction the property of the Consolidated Light & Power Company, paying therefor $200,000. Mr. Cobb represented a syndicate of New Hampshire and Maine business men. The business will be reorganized and continued under the new management.

COLUMBUS, O.—The Blind Asylum will probably soon have an electric light plant of its own. An appropriation has already been made by the Legislature for an electric light plant, but not enough was appropriated. At the next session of the Legislature an additional appropriation to be used in buying the electric plant will be asked for.

ELECTRIC LIGHT PLANT BURNED.—On the evening of Dec. 29 the plant of the People's Electric Light & Power Company, on River Street, Newark, N. J., was destroyed by fire. The regular and reserve sections of the plant were destroyed, resulting in the complete suspension of street lighting service. Only in out-of-the-way sections were gas lamps available. The streets in the city were plunged in total darkness, and to avoid accidents it was only with the greatest care that the electric cars could be kept in motion. The company will at once open its old plants in Mechanic Street, Boyd Street, the Washington House and in Harrison, which it will run temporarily. The loss by the fire is placed at $175,000 which is fully covered by insurance. Thirty-seven dynamos were destroyed. Orders have already been given for a new equipment. It is supposed that the fire started behind the switchboard.

THE ELECTRIC RAILWAY.

HUNTINGDON, PA.—The Bellefonte Central Railroad Company has in preparation plans for the extension of the line to Huntingdon.

EAST LIVERPOOL, O.—A scheme is on foot to build a second street car line out of East Liverpool and by way of East End to Smith's Ferry.

ASBURY PARK, N. J.—A new trolley line is proposed, running from Asbury Park to Eatontown and from Eatontown to Freehold by way of Tinton Falls.

ROME, GA.—Superintendent Marvin, of the City Electric Car Line, is considering the advisability of extending the line out to the Massachusetts Cotton Mills.

BABYLON, L. I.—The question of building a trolley line between the station of the Long Island Railway at Huntington and this place is being discussed.

WASHINGTON, D. C.—A bill was introduced in the House by Mr. Wellington, giving the Chesapeake Beach Railway Company the right to extend its line into the District.

HARTFORD, CONN.—Gilbert E. Norton, Charles F. Hamlin, and others will apply to the next Legislature for a charter for a trolley road from Meriden to Southington and Plainville.

AKRON, O.—The Wooster Avenue car barns of the Akron Street Railway Company, together with 130 cars, were destroyed by fire recently. The loss is $10,000 and the insurance $6,000.

WATERBURY, CONN.—It is stated that prominent residents of Naugatuck will petition the next Legislature for a charter to build a trolley line from here to Middlebury and Lake Quassapaug, returning *via* Millville, forming a belt line.

BANGOR, ME.—An electric railway will be built from Bangor up the Kenduskeag valley to the thriving towns of that section. The capital stock is $250,000 and the name of the company is the Penobscot Central Railroad Company.

FALL RIVER, MASS.—The Globe Street Railway Company has asked that a location, grant and franchise be given it to construct, electrically equip, and maintain for street railway purposes a double track road in North Main Street, in this city.

NEW ROCHELLE, N.Y.—It is reported that a company will be organized in this place and will apply for a franchise and give bonds to complete a trolley line from the present terminus in Pelham Manor through this village to Larchmont, on or before April 1 next.

WEST ORANGE, N. J.—The Township Committee has granted a franchise to the South Orange & Maplewood Railway Company to extend its tracks from the present terminus of the road in Orange Valley to connect with the Watchung Railroad at Main Street, West Orange.

RANDOLPH, MASS.—The directors of the Randolph, Holbrook & Nantasket Beach Street Railway Company, have petitioned the selectmen for a location for their tracks, commencing at the Randolph and Holbrook line to and through Union Street to a point in Central Square.

DEFIANCE, O.—On Dec. 18 a receiver was appointed for the Defiance Street Railway & Electric Light Company. Mr. Walter R. Faben, manager of the company, was appointed as such. The company was bonded in the sum of $100,000 and, according to the petition for receiver, it is heavily embarrassed.

ASHLEY, O.—A. S. Shoemaker, of Ashley, is actively engaged in the interest of establishing an electric railway from Mt. Vernon, Knox County, to Richmond, Marion County, passing through Sparta, Marengo, Ashley and Prospect. Capitalists are ready to take hold of the project as soon as the right of way is secured.

GREENWICH, CONN.—An important trolley project is disclosed by a petition to the next Legislature by the Greenwich Tramway Company, which already has considerable trolley privileges under its charter. The plan contemplates extensions westward to Port Chester and the New York State line, and eastward to Stamford, as well as other extensions around Greenwich.

CHICAGO, ILL.—The Suburban Railway Company recently filed a mortgage in Chicago, and Waukegan, Wis., for $3,000,000. It is stated that the money is to be used in changing the Northern Pacific suburban lines from steam to electric. The electric equipment will involve an expense of $1,250,000 and the rest of the money will, it is said, be utilized in extending the system.

BALTIMORE, MD.—Mr. Lauman introduced an ordinance authorizing the City & Suburban Railway Company to lay tracks on Mount Street, with the privilege of extending them on various other streets. Mr. Towson introduced an ordinance authorizing the Central Railway Company to lay tracks from Milton Avenue and Preston Street. Both ordinances were referred to committee.

HARTFORD, CONN.—The Hartford Street Railway Company will apply to the General Assembly for several amendments to its charter. One is to authorize it to construct its line from the city line through Franklin Avenue, the New Road and the Wolcott Hill Road to the village of Griswoldville and through such highways in the towns of Wethersfield and Rocky Hill as may be approved by the Selectmen of the towns.

HARTFORD, CONN.—Petitions for the incorporation of the Portland & East Hampton Street Railway Company, to run through the towns of East Haddam and Chatham, and the East Granby Street Railway Company, have been filed with the Secretary of State. The General Assembly will be asked to amend the charters of the Shelton Railway Company and the Bridgeport Traction Company so that they may extend their tracks.

ALBANY, N. Y.—The State Railroad Commission has denied the application of the Brooklyn Bridge, Prospect Park & Eastern Railway Company for permission to build about 30 miles of surface railway in the streets of Brooklyn. The proposed road is a separate corporation, and the Board states that "if additional railway facilities are required by public convenience and necessity, they can best be secured by extensions of existing street railway systems."

NASHVILLE, TENN.—The Nashville Street Railway has passed into the hands of a syndicate which will control all the street railway lines in the city, all of which are equipped and operated on the overhead trolley system. The new company will improve the road, settle its litigations, clear off all its liabilities and put it in first class condition. The new company is successor to the reorganized Nashville Street Railway Company, which was sold under foreclosure in 1894. Col. C. M. McGee, of New York, is one of the leading members of the syndicate.

KINGSTON, N. Y.—The attempt of the Ulster & Delaware Railway to cross the tracks of the Colonial Trolley Company on the Strand, resulted in a small war between the constructing forces of the two companies recently. The Ulster men had laid the crossing, when the Colonial men tore it out. It was afterward relaid, and then the Colonial Company placed a car on the crossing and refused to move it. The motorman was arrested by the chief of police for obstructing the crossing. Obstacles are still interposed to the passage of trains by the Colonial workmen, and at last reports the Ulster & Delaware people seem to have the best of the situation.

THE ELECTRIC EXTENSIONS ON THE N. Y., N. H. & H. R. R.—The large power house which is to be erected at Berlin, Conn., by the New York, New Haven & Hartford Railroad Company, reference to which was made in the last issue of THE ELECTRICAL WORLD, will be constructed of brick and iron, and will have a slate roof. In dimensions it will be 106 feet by 117 feet, and besides the steam, power and electrical equipment it will be provided with a 35-ton crane for moving and handling heavy machinery. The boiler plant will consist of 10 horizontal flue boilers, 72 inches diameter by 19 feet long, each containing 130 three-inch tubes. They will be designed to carry a pressure of 125 pounds of steam, and will be constructed by Edward Kendall & Sons, Cambridgeport, Mass There will be two improved Greene cross-compound condensing engines, the high pressure cylinders of each being 28 inches by 48 inches, and the low pressure cylinders 48 inches by 48 inches. They will run at a speed of 100 revolutions per minute. The engines will be coupled to two 12-pole 850-kw General Electric generators, with a voltage of 650 at full load. It is the company's intention to operate electrically the line between Berlin and New Britain, a distance of about 3¼ miles, and the New England Railway from New Britain to Hartford, about 12 miles. The third-rail system, similar to that used on the Nantasket Beach line, will be installed. Work was begun on the improvements on Dec. 21, and the engineers have already taken the steps preliminary to the work of bonding the traction rails and laying the third rail. The work of removing the buildings on the site of the new power house has already commenced, and it is stated that the electric system will be in operation by the 1st of March, 1897.

STRIKE ON THE WEST END SYSTEM.—A short-lived strike took place on the West End street railway system, Boston, last week. On Dec. 24, 3400 motormen and conductors of that company left their work. It is stated that this action was a violation of an agreement made between the executive council representing the employees and the directors of the West End Street Railway Company, to the effect that action on the part of dissatisfied employees should be deferred for one week. This arrangement, it is stated, caused much discontent among the employees, the result of which was the precipitation of a general strike during the morning. The tie-up came at an unfortunate time, as far as the public was concerned, on account of the holiday crowds, and much discomfort resulted. The shop keepers all over the city very severely felt the effects of the strike on their trade. The entire West End system was involved and the traffic on every division was practically tied up during the day. A few cars were run at irregular intervals, the mail cars, however, making their trips with regularity. The strike was declared off at 1.30 o'clock Christmas morning and traffic soon resumed its normal condition. According to the decision of the railway officials the new men taken on in the place of the strikers were given preference in the re-employment of the old hands. Those who struck and requested to be reinstated were given positions in the order of their applications. Considerable discontent still exists on account of the alleged severity of the railway officials in discriminating against the strikers, and especially their leaders, who have, it is stated, been dismissed from the service. Public meetings are being held, for the purpose of bringing about a more amicable feeling between the company and its employees.

Legal Notes.

KANSAS CITY, MO.—The Missouri Supreme Court in a ruling on Dec. 10, decided that a telegraph company is liable for mistakes made by it in the transmission of telegrams, and that the printed contract at the head of every telegraph message blank providing that the company shall not be liable for unrepeated messages is invalid.

ALBANY, N. Y.—The Court of Appeals has sustained the Appellate Division in the matter of tax assessment of the Consolidated Telephone & Electric Subway Company, of New York City. The Tax Commissioners had ordered a tax on the assessment of $940,000, and the Appellate Division made it only $75,000. The appeal resulted as indicated above.

THE WALKER COMPANY has commenced an assumpsit suit for $15,000 against the Glen Oaks & Prospect Heights Railway Company, Jas. E. Seiberling, Monroe Seiberling, A. G. Seiberling and Fred Patee, all of Peoria, Ill., for breach of contract. The Walker Company contracted with the company and parties named for generators and motors, and without cause the Glen Oaks Company cancelled the contract. The Walker Company is making a test case of this, and has obtained the services of the best lawyers in several parts of the country, as railway companies frequently order apparatus from manufacturers and cancel the contract without cause after the machines are built.

Personal Notes.

PROF. GALILEO FERRARIS has been appointed by the King of Italy as Senator to the Kingdom of Italy. We have not as yet learned whether this new office will interfere or not with Prof. Ferraris' university work in Turin.

HERR EMIL KOLBEN, formerly with the Oerlikon Company, Oerlikon, Switzerland, and prior to that a resident of this country, where he has a number of friends, is about to start in business for himself in partnership with Carl Bondy, in Prague, Austria, where the firm will manufacture electrical machinery, especially dynamos and motors.

MR. CHARLES K. KING, secretary of the Ohio Brass Company, Mansfield, O., has been spending the holidays most agreeably, being off on his wedding trip. On Dec. 23 he was married to Miss Edith M. Crawford, of Mansfield. His

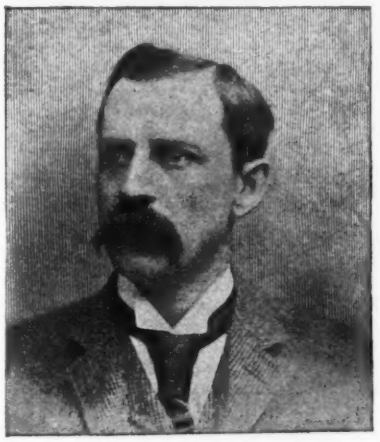
many friends will, we are sure, join THE ELECTRICAL WORLD in heartily wishing Mr. and Mrs. King a long and happy married life.

MR. H. J. GORKE, who has been for a number of years treasurer and general manager of the Electric Engineering & Supply Company, Syracuse, N. Y., has severed his connection with that company, and will embark in business for himself. Mr. Gorke's ability and wide experience will undoubtedly earn for him in his new venture the success which he merits. THE ELECTRICAL WORLD unites with his numerous friends in the electrical field in wishing him all prosperity in his enterprise.

OBITUARY NOTES.

MRS. FRANK STEWART SMITH, wife of the manager of the Sawyer-Mann Electric Company, died last week from congestion of the lungs. The numerous friends of Mr. Smith unite with us in extending him our sympathy upon this sad event. Before marriage Mrs. Smith was Miss Helen Stenger, of Chambersburg, Pa.

THE LATE HARVEY LAMB LUFKIN.—Mr. H. L. Lufkin, whose sudden and untimely death was briefly announced in the last issue of THE ELECTRICAL WORLD, was one of the most highly esteemed members of the electrical profession. His modest and unassuming bearing made for him a host of friends, who always entertained the kindliest feeling toward the deceased. His nature was warm and generous, and such was his personal influence that every one formed an attachment for the man at the first meeting. Mr. Lufkin had just returned from an extensive business trip throughout the Western States, and had hardly got settled down to business routine at his office when he was overtaken with the ailment that resulted in his sudden taking-off. Thus, at the age of 39 years, his life's work was abruptly closed. Mr. Lufkin was the first person to apply electric power to the operation of rolling mill machinery, and evidences of his foresight are now everywhere abundant in the iron industries. He was one of the early believers in the possibilities of the electric motor, and became associated with Dr. S. S. Wheeler and Prof. F. B. Crocker at the time they were just beginning the manufacture of small motors. The three gentlemen were associated in the C & C Motor Company, where Mr. Lufkin made for himself a reputation for skill and capacity of high order. When the Crocker-Wheeler Electric Company was organized in 1892, Mr. Lufkin joined his former associates, retiring from the service of the C & C Company. Largely through his intelligent business management the Crocker-Wheeler Company's business has grown to be one of the leading industries of its kind in the world. He was the first person to make an exhibition of running motors, which was at the convention of the National Electric Light Association in Philadelphia, in 1887. He became connected with the Crocker-Wheeler Company about five years ago. Mr. Lufkin was an earnest advocate and supporter of any enterprise or project that had for its purpose the advancement of electric interests, and was prominently identified with the Electrical Exposition which was held in New York last May. The deepest sympathy is felt in the electrical profession for Mrs. Lufkin in the death of her husband, and the trade at large loses an honorable member.



HARVEY LAMB LUFKIN.

Trade and Industrial Notes.

CALENDAR.—Edward P. Sharp, manufacturer's agent, 44 Niagara Street, Buffalo, has issued a monthly calendar for 1897. It has a very artistic marine view.

THOMAS C. WARLEY & CO., 11 South Ninth Street, Philadelphia, Pa., manufacturers of boiler-cleaning compounds and lubricating oils and greases, are distributing with their compliments a monthly calendar for 1897.

AJAX ENCLOSED ARC LAMP.—Pomeroy, Woltmann & Co., 43 Cortlandt Street, have issued a little pamphlet descriptive of their Ajax enclosed arc lamp. The mechanism and the various features of this lamp are well illustrated and described.

THE AMERICAN ELECTRICAL WORKS, Providence, R. I., has taken the New Year by the forelock, so to speak, and is sending out to the trade a neat calendar for 1897, on which is given a fine colored view of its mills and surroundings at Phillipsdale.

JOSEPH DIXON CRUCIBLE COMPANY.—We acknowledge with thanks the receipt from the Joseph Dixon Crucible Company, Jersey City, with its compliments, of a box containing samples of lead pencils of several varieties of shapes and colors; also samples of erasing rubbers.

BRYANT ELECTRIC SPECIALTIES.—The Bryant Electric Company, Bridgeport, Conn., has issued a supplement to its regular catalogue of Bryant supplies. It relates to baby knife and other switches, tablet boards, wall sockets, receptacles, etc., etc. The price of each article is also given.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, New York, has just issued a catalogue descriptive of its "Manhattan" direct-current enclosed-arc lamps. The catalogue is very handsome and attractive, and includes a lucid description of the interesting and novel mechanism of these well-known lamps.

BRIDGE EQUIPMENT WANTED.—The contract for the Grand Avenue bridge at New Haven, Conn., has been awarded to the Berlin Iron Bridge Company, East Berlin, Conn. The draw of this bridge will be operated by electricity, and the Berlin people are now in the market for this equipment, including motors, wiring, etc.

MR. H. WARD LEONARD calls attention to the numerous uses and advantages of the "booster" method of regulating voltage. Mr. Leonard was recently granted a very broad patent relating to the "booster" system and he announces that users of the system may obtain licenses from him upon very reasonable terms.

THOS. J. FAY & ASSOCIATES, 143 Liberty Street, New York, New York agents and general exporters for the Crocker-Wheeler Electric Company, have been awarded the contract for the lighting plant for Hull & Co., of Poughkeepsie, N. Y. The dynamo will be one of the latest perfected multipolar Crocker-Wheeler machines, of 600 lights capacity.

THE STANDARD AIR-BRAKE COMPANY, 100 Broadway, New York, of which Mr. E. J. Wessels is general manager, has just published an interesting little booklet containing useful information regarding the Standard air-brakes and accessories. The book is neatly illustrated, and the many advantages of employing air-brake equipments upon street railways are clearly and concisely discussed.

"ELECTRIC LIGHT AND POWER" is the title of a catalogue issued by Mavor & Coulson, Glasgow, Scotland, a copy of which we have just received. Besides describing and illustrating various electrical apparatus and devices, the catalogue gives much information of a general character pertaining to the application of electricity to light and power purposes. A complete telegraph code is also included.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Ia., has just issued a pamphlet entitled "As an Investment," which presents in a concise and forcible manner the advantages from a purely financial point of view of providing sufficient lightning arresters to afford proper protection to electrical apparatus. The pamphlet contains a list of some of the largest railway and other companies using the Garton arresters.

THE RECEIVERS' SALE of the entire stock of electrical supplies of The E. S. Greeley & Co. is a *bona fide* opportunity for all buyers, large and small, to supply their wants in this line at unusually low prices. The receivers' motto is "first come, first served" with all bids and offers, subject of course to prior sale. This should be a good time for the provident buyer to lay in a generous stock against the anticipated active Spring trade.

THE NEW YORK & NEW JERSEY LUBRICANT COMPANY, 30 Cortlandt Street, New York, is making large sales of Kent's lubricating compound. Every portion of this compound is said to be a lubricant, but the component parts are combined to form a homogeneous mixture. It is claimed that 350 degrees of heat are required to melt it. This compound is now in use in a large number of plants and its popularity is constantly increasing.

THE SHULTZ BELTING COMPANY, St. Louis, Mo., in accordance with its annual custom, has issued a very pleasing New Year greeting in the form of a handsome calendar for 1897. The company will be pleased to forward a copy to any one enclosing a 3-cent stamp for postage. If more convenient, requests may be sent to Mr. A. B. Laurence, manager of the New York office, 113 Liberty Street, or any of the other agents of the company.

KLEMM & CO., corner Fifth and Cherry Streets, Philadelphia, Pa., are selling large numbers of the Klemm adjustable desk shades and adjustable show window reflectors. This firm manufactures electric light reflectors and shades in many styles and shapes suitable for use in residences, halls, stores offices or wherever it is desired to concentrate the light at a particular point. They can be adjusted to reflect the light in any desired direction.

H. B. COHO & CO., 203 Broadway, New York, with their usual energy and ability are pushing the sale of Eddy generators and motors, Royal alternators and transformers, Tonkin boilers, tanks, etc., Crown brushes and translucent fabric, which is a patent unbreakable substitute for glass. This firm has just issued a very neat little calendar for 1897, upon the back of which is printed a list of some of the principal plants installed by it during the year 1896.

THE PITTSBURG BOILER SCALE RESOLVENT COMPANY, Pittsburg, Pa., has issued a little book entitled "Incrustation and Corrosion," in which methods of overcoming these enemies of steam boilers are discussed, and the advantages of employing the Pittsburg Boiler Scale Resolvent for this purpose are explained; full directions for using the resolvent are also given. The company will take pleasure in mailing a copy of this pamphlet to any one who applies.

LARGE LEATHER BELTS.—In the station of the People's Light & Power Company, Newark, N. J., there are three large "Monarch" leather belts which were supplied by the Bradford Belting Company, Cincinnati, through Emil Gabel & Co., New York. The dimensions of these belts are as follows: One 70-inch, 3-ply, 129 feet 9 inches long; one 48-inch, 3-ply, 129 feet 9 inches long; one 36-inch, 2-ply, 69 feet 1 inch long. This is said to be the largest belt order ever placed in the East.

THE ASHCROFT MANUFACTURING COMPANY, 111 Liberty Street, New York, has just issued a very complete and attractive illustrated catalogue of the different specialties made by it. Among these may be mentioned the Edson pressure recording and alarm gauge, the Tabor steam engine indicator and the Mosscrop speed regulator. The catalogue contains much information of value to steam users, and as a book of reference it will be found very useful to those interested.

THE KELLY & JONES COMPANY, Greensburg, Pa., has just issued a price list and catalogue, giving dimensions of standard flanged fittings and long-turn water fittings. The company manufacturers cast-iron fittings of all kinds, screwed and flanged, and a complete line of goods for steam and hot water heating. The catalogue is very completely gotten up and gives accurate

information for engineers to enable them to lay out their work and avoid the trouble and delay of writing for dimensions.

HANDSOME CALENDAR.—The *Iron Age*, in conjunction with the *Metal Worker* and *Carpentry and Building*, has sent out a handsome wall calendar for 1897, printed by the Williams Printing Company, 232 to 238 William Street, New York. The design is excellent and was originated by the publishers of the *Iron Age* in 1876, since which time it has been extensively imitated. The new issue contains a number of improvements in details, and the typographical work reflects great credit upon the Williams Company.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., has recently issued a neat descriptive catalogue and price list of the numerous electric lighting appliances which it manufactures. Illustrations and dimensions of various articles are given, including distributing terminal and fuse boxes; also several forms of junction and wall outlet boxes, etc. This company's boxes are all fire-proof, being made of iron or steel, and are specially adapted for use in connection with brass or iron armored conduit.

THE NEW HAVEN CAR REGISTER COMPANY, New Haven, Conn., reports a constantly increasing demand for its registers, both in this and foreign countries. The company's double and triple machines are becoming very popular. Among the cars recently equipped with the double machines are those on the Market Street line in San Francisco, the Richmond Traction Company, Richmond, Va., and the new cars of the Syracuse Rapid Transit Company, Syracuse, N. Y. Other large contracts are pending.

THE HOLLAND TORPEDO BOAT.—The submarine torpedo boat, which will be launched at Baltimore shortly, is equipped with an entire outfit of Blake pumps, made by the George F. Blake Manufacturing Company, 95-97 Liberty Street, New York. One of these pumps is of special design, and is to be used in connection with the system for submerging or raising the boat when necessary during its manœuverings. The Blake Company is also equipping with Blake pumps all of the torpedo boats now being built for the United States Navy.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Kokomo, Ind., in its catalogue No. 5, dated Dec. 1, 1896, fully describes and illustrates its various telephone devices and apparatus, and gives besides considerable information of interest regarding telephones in general. A novelty is the "Hunnings-Burns" hygienic telephone transmitter, the object of which is to minimize the possible danger of contracting any infectious disease which may result from general use of the same mouthpiece. A square, plane surface is substituted for the usual mouthpiece.

THE BARNARD WATER COOLING SYSTEM.—The Wheeler Condensing & Engineering Company, 120 and 122 Liberty Street, New York, in a neat pamphlet just issued, describes the Barnard Water Cooling Tower, of which the Wheeler Company is the sole manufacturer under the patents. The "Barnard" water cooling tower permits any engine and unit of power to be operated condensing with a high degree of vacuum, no matter where the plant may be located. The subject of the pamphlet is well illustrated, as are also the Wheeler condenser and Wheeler feed water heaters.

LARGE BRIDGE CONTRACT.—The counties of Ocean and Monmouth, N. J., have just awarded the contract for a bridge between Point Pleasant and Manasquan to the Berlin Iron Bridge Company, East Berlin, Conn. This bridge will be one of the longest highway bridges in the United States, and is to be 1910 feet in length. The Secretary of War has ordered a draw span constructed in this bridge, which will give two clear openings, one of 45 feet and the other of 50 feet. The Berlin Iron Bridge Company's contract includes the substructure as well as the superstructure for the bridge.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, Pa., manufacturers of the Cochrane separators and heaters, report the following recent sales in the electrical field: Separators—Quakertown Electric Light Company, Quakertown, Pa., 6 inch; Diamond Electric Company, Philadelphia, 10 inch; People's Light & Power Company, Jersey City, N. J., 10 inch. Heaters—Ithaca (N. Y.) Street Railway, 200 horse-power; Akron (O.) Street Railway & Illuminating Company, one 2000 horse-power; Diamond Electric Company, Philadelphia, one 1000 horse-power; Manufacturers' Electric Company, Philadelphia, one 800 horse-power.

A NOVEL PAPER WEIGHT.—We have received from the Mitchell Tempered Copper Company, Corry, Pa, a paper weight of novel design. It consists of a miniature figure of an ox made of solid tempered copper. It is well proportioned and is a good example of the excellence of the products of this concern. The Mitchell Company manufactures pure copper castings for all electrical appliances. Purity, solidity and durability are the main qualities of its copper, and its goods are of even temper and uniform gauge. The company makes a specialty of segments and bevel bars. Mr. J. G. Ruhl is secretary and treasurer of the company, and Mr. Dan. Mitchell superintendent.

SEARCHLIGHTS.—Carlisle & Finch, Cincinnati, O., manufacturers of electrical novelties, report that they have sold several thousands of the various electrical toys manufactured by them, and that they have been compelled to run their factory night and day to keep up with the demand. The firm contemplates the production of other electrical novelties, such as boats, fountains, pumps, etc., also larger electric cars to run on straight track. Among the other manufactures of this concern may be mentioned focusing lamps and searchlights for all purposes, also locomotive electric headlight apparatus. Perfection in design and workmanship characterize all of the goods turned out by this firm.

MR. E G. BERNARD, of the E. G. Bernard Company, Troy, N. Y., was in New York last week. Mr Bernard reports business extremely good and that since election his company has been so much rushed that the employees have had to work overtime. Mr. Bernard reports recently closing the following contracts: Two complete lighting plants in Mexico, making five plants within the last five months in the same city; two machines for New York City, one for Philadelphia, one for Chicago, one for Pittsburg, two for Granville, N. Y., two for Lansingburgh, N. Y., one for Brownville, N. Y., one for Hudson, N. Y., one for Watertown, N. Y., one for Elmira, N. Y., one for Binghamton, N. Y, two for Amsterdam, N. Y., one for Catskill, N. Y, two for Troy, N. Y., besides several small machines.

THE SCHUYLKILL FOUNDRY & MACHINE WORKS, Conshohocken, Pa, manufacturers of Wood's watertube boilers, report the following orders: Richard Hecksher & Sons' blast furnace, two orders, 1000 horse-power; Duncannon Iron & Steel Company, three orders, 900 horse-power; J. Wood & Bros. Iron & Steel Company, three orders, 1500 horse-power; The Ellis & Lessig Iron & Steel Company, 500 horse-power; The E. & G. Brooke Iron & Steel Company, two orders, 800 horse-power; Pottsville Iron & Steel Company, 200 horse-power; Schuylkill Electric Railway Company, 1000 horse-power; Norfolk & Oceanview Electric Railway Company, 1000 horse-power; Reading & Southwestern Railway Company, 300 horse-power; Cheltenham Electric Company, 300 horse-power; Jenkintown Electric Company, 300 horse-power; The Philadelphia Milling Company, 300 horse-power; The John C. Miller Brewing Company, 500 horse-power. Many orders have also been received for these boilers at the works of the company at Saginaw, Mich., New Haven, Conn., and at Zanesville, O.

THE ACME FILTER COMPANY, 1200 Collins Street, St. Louis, Mo., reports an encouraging business during the past month. Some of its sales are given in the following list: Leonard & Ellis, St. Louis; Vacuum Oil Company, New York City and Rochester, N. Y.; E. F. Houghton & Co, Philadelphia, Pa.; Waters-Pierce Oil Company, St. Louis; the Fred W. Wolf Company, Chicago; Rockford Sugar Refining Company, Rockford, Ill.; J. F. Rogers & Co., New York City; J. L. Lindsay, Richmond, Va; Davis Coal & Coke Company, Thomas, W. Va.; E. Keeler & Co., Williamsport, Pa.; Susquehanna Silk Mills, Sunbury, Pa.; Great Western Manufacturing Company, Leavenworth, Kan.; Arkansas City Milling Company, Arkansas City, Kan.; Ohio State Reformatory, Mansfield, O.; the McIntosh & Huntington Co., Cleveland, O.; Atlanta Cotton Mills, Atlanta, Ga.; Geo. F. Young, Buffalo, N. Y.; Fulton Bag & Cotton Mills, Atlanta, Ga.; Wisconsin School for Blind, Janesville, Wis.; T. B. Bickerton & Co., Philadelphia, Pa.; Claremore Milling Company, Claremore, I. T. Waters-Pierce Oil Company, St. Louis, Mo.; Moses P. Johnson Machine Company, St. Louis, Mo.; H. P. Smith Oil Company, Chicago, Ill.; M. S. Nab & Harlin Manufacturing Company, New York, N. Y.; McGrew Milling Company, Coffeyville, Kan.; Leonard & Ellis, St. Louis, Mo.; Andrew Cummings, Chicago; Smith Courtney Company, Richmond, Va.; Leonard & Ellis, Philadelphia, Pa., and the Houston Electric Street Railway Company, Houston, Tex.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

EVERYDAY EXCURSIONS to all parts of the world can be arranged for any day in the year, for one or more persons, upon application to any principal ticket agent of the Chicago, Milwaukee & St. Paul Railway. Itineraries carefully prepared for excursions to California, Florida, Mexico, China, Japan and to any part of Europe. Estimates furnished, including all expenses. Tickets furnished for the complete journey. It is not necessary to wait for any so-called "Personally Conducted Excursions." In these days of progressive enlightenment, with the English language spoken in every land under the sun, one does not need to depend upon the services of guides for sight-seeing but can go it alone or in small family parties, with great comfort and security and at one's own convenience. Write to E. F. Richardson, General Agent Passenger Department, Chicago, Milwaukee & St. Paul Railway, New York City, for details if you are contemplating a trip.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 22, 1896.

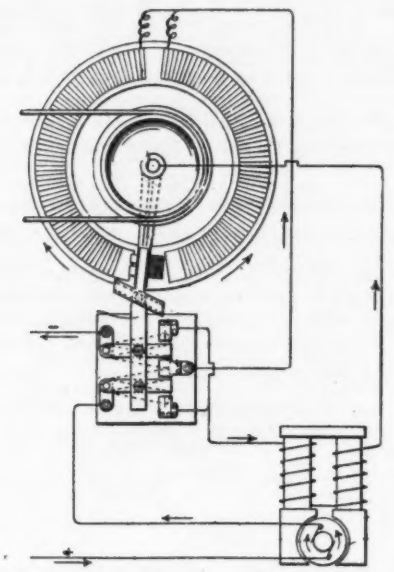
[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

573,441. TELEPHONE ATTACHMENT; W. O. Christopher, Hillsborough, Tex. App. filed Aug. 29, 1895. A telephone attachment comprising an oblong loop, insulated for a portion of its length and the main portion of which is sufficiently wide to be passed horizontally over the outer hook end of a telephone switch-lever, said loop being provided at both ends with elongated contracted necks, one of which necks is adapted to engage the shank of said switch-lever in rear of said hook and to allow the loop to normally assume a vertical position, and thereby detachably lock itself on the switch-lever, and a hook connection between the other contracted neck of the loop and the receiver wires, whereby a dropping of the telephone-receiver will exert a pull on the switch-lever through the medium of said loop.

573,464. ELECTRIC ARC LAMP; E. P. Hopkins, New York, N. Y. App. filed June 13, 1894. In an arc lamp, the combination with the carbon-holders, of a spring clock-train having an initial tension and mounted in a frame having a fixed position, said clock-train acting to positively feed the carbons together, a regulating electromagnet for controlling the feeding movement, located in a constantly-closed shunt-circuit around the arc and

blocking the clock-movement in the retracted position of its armature, and an electromagnet located in series with the arc and acting to separate the carbons to form the arc independently of the feeding mechanism, whereby varying quantities of current may be passed through the lamp without affecting the regulation thereof.

573,485. PROCESS OF AND MACHINE FOR MAGNETIC SEPARATION; R. H. Sanders and C. T. Thompson, Philadelphia, Pa. App. filed Aug. 10, 1892. A process of magnetic separation, which consists in feeding stock into a diffusedly-shunted field between a magnet and a moving armature of substantial continuous mass, conducting the ore through said field suspended in striæ supported at the end farthest from the magnet, and thereby delaying the passage of the ore through the field, permitting the gangue to escape during the period of delayed conveyance, removing the ore from the field still supported, and finally discharging it.



No. 573,531.—ELEVATOR.

573,493. ELECTRIC BATTERY; A. E. Stephenson, Chicago, Ill App. filed June 29, 1896. The combination in an electric battery, of pockets with a battery case, the said pockets being a part of the battery casing; a cover connected with the battery casing by a hinge, the said cover provided with two spring-latches fixed on top of said cover at two points of equal distance from the hinge extending down the side of the battery case at a right angle to the plane of said cover in contact with and clutching a screw, the said latches and hinge connected with the negative electrode through the screw.

573,496. APPARATUS FOR PREVENTING COLLISIONS ON ELECTRIC RAILWAYS; B. C. Tilghman, Philadelphia, Pa. App. filed April 13, 1894. The combination with the crossing tracks, and an electric conductor extending along one track for supplying electricity as a motive power, of means under the control of a train moving along the other track, for temporarily cutting the electricity from a portion of said conductor along the first-named track.

573,517. TROLLEY POLE GOVERNOR; V. T. Lynch, Chicago, Ill. App. filed March 4, 1896. In a controlling device for trolley poles, the combination with a reel or drum upon which the rope or cord connected with the trolley pole is adapted to be wound, of a spring for rotating the said drum to maintain the rope taut, a second reel or drum, a spring for rotating the said second drum to wind the rope thereon, and means controlled by the rapid rotation of the first-named reel or drum as the tape is unwound therefrom for throwing the said second-mentioned spring into action to wind the rope upon the second drum and draw the trolley arm downward.

573,526. ELECTRIC ARC LAMP; E. H. A. H. R. Von Nollendorf, Vienna, Austria-Hungary. App. filed April 9, 1896. In an arc lamp, the combination with the frame and two carbon holders thereon, of a drum pivoted on the frame to turn in a horizontal plane, a cord connected to the upper carbon holder and drum, an escapement-wheel adapted to turn independently of the drum in one direction, means for locking the drum and escapement-wheel together, a pallet pivotally mounted on the frame to swing in a horizontal plane, in operative connection with the escapement-wheel, a magnet for operating the pallet and conductors electrically connected with the carbons and magnet.

573,531. ELEVATOR; C. R. Pratt, New York, N. Y. App. filed June 29, 1891. The combination with a travelling elevator and an electric motor to operate the same, of a current-regulator and a circuit-reverser on the elevator-car, a hand-wheel and a cable connecting it with and to positively operate said current-regulator and circuit-reverser.

573,535. TROLLEY ADJUSTING AND REGULATING DEVICE; C. F. Randall, Denver, Cal. App. filed March 31, 1896. The combination of a casing comprising two compartments, the first compartment having a weight provided with a yielding pin, a block and pulley attached to said pin, the pulley being engaged by the trolley-rope, a pawl attached to the yielding pin, a ratchet-bar having a limited movement within the compartment, a pulley supported in the upper part of the compartment and over which the trolley-rope passes, another pulley supported in the upper part of the second compartment and also engaged by the trolley rope, a weight located in the second compartment and to which the trolley-rope is attached, and a spring-held dog suitably supported and having one extremity nominally projecting into the path of the ratchet-bar, while the other extremity engages and supports the weight in the second compartment.

573,558. ELECTRICAL RESISTANCE DEVICE; D. C. Voss, Malden, Mass. App. filed March 16, 1896. As an article of manufacture, a solidified electric conductor, composed of carbonized fibrous material, a metallic oxide, and a binder.

573,575. TELEPHONE EXCHANGE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed June 11, 1896. The combination with a metallic circuit and grounded telephone lines of a common battery and an additional battery in circuit with the grounded lines and adapted to supply additional E. M. F. to the grounded lines, whereby the standard current may be maintained upon both metallic circuit and grounded lines.

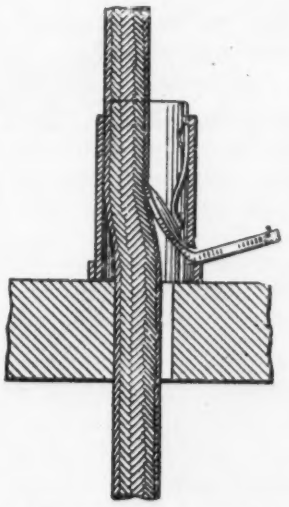
573,576. COMMON BATTERY TELEPHONE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Sept. 19, 1896. The combination of a local transmitter circuit, comprising an induction coil and a microphone included in circuit with said induction coil, and a battery adapted to direct current through the primary and secondary helices of said induction coil in series, said primary and secondary helices being also connected in series in the path of the voice currents.

573,581. ELECTRIC ENGINE; I. T. Dyer, Chicago, Ill. App. filed March 30, 1896. An electric motor comprising in combination with an electric generator, a pair of solenoid-magnets and their cores coupled endwise together, a lever connected with said cores to be oscillated by their reciprocating movement and adapted to be connected with the driver of an engine, and a switch device having a pair of stationary contacts in the generator-circuit and a pair of spring-controlled movable contacts adjacent to said stationary contacts and respectively connected, electrically, with said magnets, a pendulously-supported lever extending between said movable contacts, and shifting-lever mechanism engaging said pendulous lever.

573,591. ELECTRIC SIGNALING APPARATUS; F. B. Herzog and S. S. Wheeler, New York, N. Y. App. filed March 12, 1885. The combination, in signaling apparatus, of a transmitter, a signal-changer, together with a signal designator, consisting of an indicating surface or "field," bearing indications grouped in two substantially intersecting directions, cooperating with an indicator, one of these movable with respect to the other is such manner as to designate any desired indication; together with means whereby the signal transmitted is varied to correspond with the indication.

573,592. ELECTRIC SIGNALING APPARATUS; F. B. Herzog and S. S. Wheeler, New York, N. Y. App. filed Jan. 20, 1886. At a sending station a transmitter organized to transmit two separate variable signals at one transmission, and at a receiving station an apparatus comprising two progressively moved elements each controlled by a magnet, the first magnet being controlled by the first part of the transmission, and the second magnet by the second part.

573,601. ELECTRIC SWITCHING APPARATUS; F. W. Jones, New York, N. Y. App. filed Oct 15, 1896. The combination in a switchboard of a spring jack, two or more flexible cords, a plug for each cord, a take-up device for each cord and a means for locking or holding a cord against the action of said take-up device.



No. 573,601.—ELECTRIC SWITCHING APPARATUS.

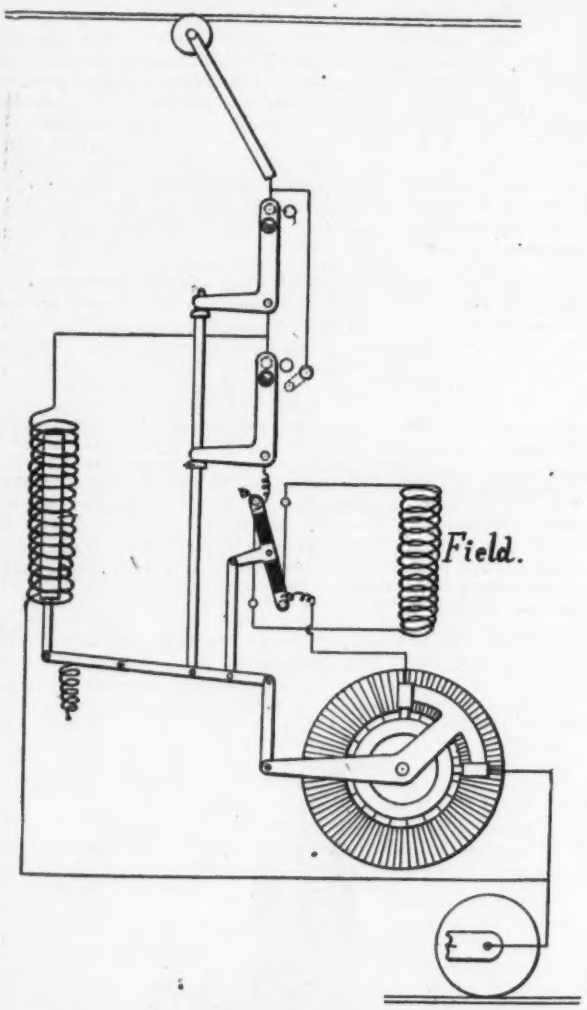
573,612 ELECTRICAL CONNECTING CORD; C. H. McEvoy, Lowell, Mass. App. filed Feb. 24, 1896. A flexible electric conductor, comprising a conducting-core, a conducting-tip in electrical connection with said core, a non-conducting supporting cord, and a link arranged to surround said tip and to receive said supporting cord.

573,617. ELECTRIC ARC LAMP; P. F. H. Queisser, Charlottenburg, Germany. App. filed Jan. 24, 1896. In an arc lamp, the combination with an electromagnet having a laminated core, the two ends of which are cut away obliquely in one plane, of a pivoted armature-lever, the movement of which controls the feeding of the carbons, and the laminated armature carried upon said lever and adapted to vibrate between the parallel

poles of said core. The axis of t armature being substantially parallel to the oblique face of the ends or poles of the core, the face of the armature opposed to the parallel edges of said poles being tapered to thereby gradually decrease the air gaps as the armature is attracted.

573,629. ELECTRIC HEATER; H. L. Tyler, Corning, N. Y. App. filed Aug. 6, 1896. An electric heater comprising an electric conductor, an insulating-inclosure within which the conductor is contained, a body of practically non-conducting liquid within the inclosure, and an outer heat-radiating body.

573,645. AUTOMATIC SYSTEM OF DISTRIBUTION AND CONTROL FOR ELECTRIC RAILWAYS, ETC. W. H. Cooley, Brockport, N. Y. App. filed Aug. 3, 1895. In an electric railway system, a continuous feeder, a series of working conductors, normally unsupplied with current from such continuous feeder sufficient to operate the motor cars on such system, means, under the control of devices on the motor cars of such system, for connecting directly to such continuous feeder, the working conductors contained on any block in such system on which a first one of such motor car happens at any time to be, means for preventing a second motor car subsequently arriving on an adjacent block, whether to the rear or in the front of such first-named block, from similarly connecting to such continuous feeder the working conductors contained on such adjacent block or section in such system.



No. 573,645.—Automatic Railway Control.

573,647. SYSTEM FOR GENERATING AND DISTRIBUTING ELECTRICAL ENERGY; C. M. Green, Cleveland, O. App. filed May 23, 1896. The combination with a dynamo-electric machine having two or more separate groups or seats of armature coils or bobbins, of two or more separate working circuits, each of which is electrically connected with the positive end of one group of armature coils and with the negative end of another group of armature-coils, and automatic cut-outs for automatically switching out of operation any one of the working circuits if broken or open-circuited.

573,670. REGULATOR FOR ELECTRIC HEATERS; A. D. Lagrelle, Louvres, France. App. filed Jan. 29, 1894. In combination with a water-closet seat, an electric resistance coil attached to the frame of the seat, and an automatic switch controlling the electrical connection of the resistance of an expansion-rod, a pivoted spring actuated piece adjusted to be thrown by said rod, a spring-actuated contact-maker adapted to be thrown out of contact by the pivoted spring-actuated piece, and a spring-actuated latch operating with the contact-maker.

573,716. ELECTRIC SIGNAL OPERATING DEVICE FOR RAILWAY TRAINS; G. F. and F. K. Singer, Mingo Junction, O. App. filed May 22, 1896. A train signal comprising a battery and an alarm at each end of the train, circuit-wires in which the batteries and signals are located, and a coupling for said wires comprising two casings, a block of insulating material in each casing, resilient contact fingers secured to the opposite sides of the blocks, the free end of each contact finger being curved inward and then outward, and a thin plate of insulating material extended from the block of each section, between and nearly to the end of the contact-fingers, whereby when the two coupling sections are placed together the plate of one section will rest upon the plate of the other section.

573,723. ELECTRIC FLOOR-PUSH; H. C. Thomson, Boston, Mass. App. filed March 28, 1896. For an electric floor-push, the combination of a plate, an insulated plug attached thereto, a helical spring, a circuit-spring and a second circuit-spring which is longer than the first circuit-spring, and a circuit-closing pin.

573,741. ELECTRICAL METAL SEPARATOR; H. H. Whitacre and A. C. Wolfe, Wellsville, O. App. filed Nov. 8, 1895. The combination of a magnet having the faces of its oppositely-placed poles recessed to form a passage or conduit, and a mass of diamagnet metal embraced between the opposite faces of the poles and extending longitudinally of said passage and adapted to divide the current and deflect the material toward the poles.

573,750. COMBINED LIGHTNING AND WATER CONDUCTOR; L. Adams, Buffalo, N. Y. App. filed Sept. 30, 1896. A joint for uniting two sections of the connected adjacent pipes, both open on one side and forming a combined lightning and water conductor, such joint consisting of twin-apertured plates having registered surfaces and provided with side-apertured lugs for securing the plates together at the registering surfaces, the slides of plates opposite the registering surface being provided with hollow tapering extensions adapted for union with the ends of the combined lightning and water conductor sections.

573,767. AUTOMATIC SPEED REGULATOR FOR ELECTROMOTORS; L. Denayrouze, Paris, France. App. filed Nov. 26, 1895. A governor for electric motors, comprising a contact disc mounted on the motor shaft and connected with one brush of the commutator, a disc mounted on, and insulated from the motor shaft and provided with a contact, electric connection of said disc with the generator, and a contact having a flexible connection with the shaft and adapted to engage the former contact.

573,807. ELECTRIC SWITCH; W. and H. Boardman, Lancaster, Penn. App. filed March 28, 1896. The combination of the base having an opening, arms projected from the inner side of the base and in a direction parallel with the longitudinal extent of the base opening, the push-pin extending through the base-opening, a transverse bar between its ends secured to the inner end of the pin and at one end extended between and guided by the arms, a switch-throwing device carried by the opposite end of the arm and a switch.

573,809. ELEVATOR MECHANISM; J. H. Clark, Boston, Mass. App. filed July 28, 1890. In an elevator mechanism, the combination of the following instrumentalities, *viz:* Two worm gears in mesh with each other, one of the gears having its shaft provided with screw threads, a worm shaft having worms in engagement with the said worm gears, an electric motor, its armature, and independent coupling connecting the said armature shaft directly to the worm-shaft, a resistance in circuit with the motor, a lever co-operating with said resistance, a shaft provided with an eccentric, a rack bar connected with said eccentric, a pinion in mesh with said rack bar, and to which the resistance lever is connected, gearing to connect the screw-threaded worm gear shaft with the shaft, an electric brake mechanism and a pole changer in circuit with the motor and brake mechanism.

573,819. ELECTRIC RAILWAY; P. W. Leffler, Chicago, Ill. App. filed Aug. 12, 1895. The combination with field magnets extending along the line of travel, of a series of co-operating magnetic sections arranged longitudinally of the car, and a controller on the car for rendering said magnetic sections operative or inoperative, cumulatively, in pairs, one on each side of the centre of the said armature.

573,820. ELECTRIC ELEVATOR; P. W. Leffler, Chicago, Ill. App. filed Aug. 19, 1895. In an elevator, the combination with the car provided with an armature of combined magnetic field-producing devices and guide extending along the line of travel, for co-operation with said armature and car, to propel the same.

573,821. ELECTRIC RAILWAY, ETC.; P. W. Leffler, Chicago, Ill. App. filed Sept. 26, 1895. The combination with a car or other traveling body, of field-magnets extending along the line of travel, and a rotary magnetic body, carried by said car-body, having one or more spirally arranged pole pieces subject to the action of said field.

573,822. ELECTRIC RAILWAY, ETC.; P. W. Leffler, Chicago, Ill. App. filed March 11, 1896. The combination with a car or other traveling body, having an armature, of field magnets, in the line of travel, and supply circuit connections for said field, arranged to divide the same into successive sections, adapted to be connected up, in series, into the supply circuit, and including, as parts thereof, a series of automatic switches which normally cut the field-section magnets entirely out of the supply-circuit, but are operative, by the car, to close into the supply circuit the particular section or sections of the field over which the car is passing.

573,823. MOTOR CAR TRUCK; P. W. Leffler, Chicago, Ill. App. filed March 21, 1896. The combination with a sectional truck, of a sectional armature, carried, one section on each of said truck-sections, and a common universal joint or joints applied to couple together said truck-sections and said armature sections.

573,830. ELECTRIC ARC LAMP; J. A. Mosher, Chicago, Ill. App. filed Oct. 22, 1896. In an electric arc lamp, the combination with a vertically-reciprocating carbon holder, of a ratchet wheel, mechanical connection between the holder and the wheel whereby they move together, a lever, a pawl for co-operating with the ratchet, and being pivotally attached to the lower, a spring for holding the pawl to the limit of its movement upon its pivot toward the ratchet wheel, an electromagnet connected with the lever and adapted to move it to bring the pawl into engagement with the ratchet wheel so as to raise the carbon holder, and a retractile spring acting upon the lever in opposition to the electromagnet.